Bats (Mammalia: Chiroptera) from Indo-Australia

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Synopsis

Accessions of Indo-Australian bats to the collections of the British Museum (Natural History) during the past fifteen years are reviewed in detail, with a particular reference to the collections made in Papua New Guinea and Sulawesi by 'Operation Drake'. Numerous species and species groups from the region are examined and in some cases revised; a new species of *Hesperoptenus* from Sulawesi and a new subspecies of *Myotis adversus* from the New Hebrides are described. The more important taxonomic studies and notes made in this study and the new range records that it reports are listed in a terminal summary.

Introduction

A variety of collections of bats from the region bounded by India in the west and the New Hebrides, New Caledonia and Fiji to the east has been received at the British Museum (Natural History) during the years 1967–1982. Some have come from individuals who have obtained small numbers of bats while visiting the region, others from large, organised expeditions that have carried out biological studies, or by donation from workers connected with organisations and institutions in the area. Individually much of this newly accessed material scarcely justified separate publication and record, although often unusual or of taxonomic or faunal interest.

Towards the end of this period, however, extensive collections of bats were made in Papua New Guinea and in Sulawesi by Mr Ben Gaskell, an ecologist and collector with 'Operation

Drake', the commemorative round-the-world voyage of the brigantine *Eye of the Wind* in 1978–1980 that marked the 400th anniversary of the circumnavigation of the world by Sir Francis Drake in the *Golden Hind*. The voyage was interrupted from time to time so that the scientists, technicians and young people aboard could undertake adventurous, scientific or voluntary aid projects in various parts of the world. Bats were collected in Indo-Australia during two of these periods, first at and around Buso and Wau in Morobe Province, Papua New Guinea, and later in central Sulawesi, chiefly around Morowali where the objective was ultimately to prepare a Management Plan for the Morowali Nature Reserve.

The study of the specimens obtained by 'Operation Drake', especially of those from Sulawesi, has entailed a further and more wide-ranging examination of much of the Indo-Australian bat collection already in London, and has prompted a further examination of the more recently accessed material that has not before been reported in the literature. In particular it has led to further study of a number of long standing taxonomic problems in the area and to some taxonomic changes. Although basically this paper is concerned with specimens obtained through the explorations initiated and carried out through 'Operation Drake' it has thus been possible to add a variety of other studies and notes drawn from material from other localities and sources, much of it directly relevant to the 'Drake' collections.

Place names in many parts of the Indo-Australian region can present difficulties, there being sometimes a choice of as many as three variants of any one designation. In general the traditional and conventional European spelling or usage (i.e. Amboina, Ceram) has been adopted but Sulawesi has been used throughout for Celebes, this name having come into general use: however, the New Hebrides remain so called, although recently renamed Vanuatu. The Indonesian part of New Guinea appears as West Irian, while Papua New Guinea is used for the rest of the island: here, 'Province' has been omitted from locational data so that localities appear as 'Wau, Morobe' i.e. Wau, Morobe Province. Further west, Borneo is used as a general term for the entire island, divided into Sarawak, Sabah, Brunei and Kalimantan.

Measurements of specimens are in millimetres and with the exception of those of individual teeth have been made with a dial-reading micrometer. Teeth have been measured with a mechanical stage fitted to a stereoscopic microscope. Although no standard suite of external and cranial measurements has been used, conventional measurements are given where required, amplified in particular cases to conform with those employed by the describer or by previous workers on the species concerned. To avoid repetition, a notation has been adopted for the wing elements whereby III^m for example indicates the metacarpal of the third digit, III^1 its first phalange, III^2 its second: when length measurements of these elements are given in the text these designations appear without preamble.

Systematic Section

MEGACHIROPTERA
PTEROPODIDAE
PTEROPODINAE

Rousettus amplexicaudatus stresemanni Stein, 1933

Rousettus stresemanni Stein, 1935: 91. Japen (=Jobi) I, Geelvinck Bay, NE West Irian.

SPECIMENS EXAMINED. Papua New Guinea: ♂ BM(NH) 69.1416 Madang, 5° 14′S, 145° 45′E (skin, skull; coll. J. I. Menzies); ♂ BM(NH) 73.1967 Rauit, West Sepik, 525 m, 3° 36′S, 142° 15′E (in alcohol;

coll. Aberdeen University Exploration Society Expedition to New Guinea, 1973); 3♂♂ BM(NH) 78.850–852 Baku Forest Station, Gogol Valley, Madang (78.850, 851 in alcohol, skull of 78.850 extracted, 78.852 skin only; coll. P. A. Morris); ♀ BM(NH) 78.853 Baiyer R, c. 50 km NW of Mt. Hagen, Western Highlands (in alcohol, skull extracted; coll. P. A. Morris).

REMARKS. Until recently there have been few records of *stresemanni* and for many years (Laurie & Hill, 1954) it has been considered a distinct species co-existing in New Guinea with *R. amplexicaudatus brachyotis* (Dobson, 1877). Latterly, however, a number of reports from Papua New Guinea has appeared, McKean (1972) recording a series of *stresemanni* from Ihu, Greig-Smith (1975) a specimen (listed above) from Rauit, with a record of an example (also listed above) from Madang first noted (in litt.) by Menzies, and with Koopman (1979) reporting material from Bagabag I, off the northeastern coast near Madang and later (1982) from Dabora, Tapio and Mornuna, Milne Bay, east Papua New Guinea. Menzies (1977) tentatively referred sub-fossil remains from Kiowa in Ghimbu Province to *stresemanni.* Finally, Rookmaaker & Bergmans (1981) have listed numerous records from localities in much of New Guinea, some evidently based on specimens previously identified as *R. a. brachyotis.* Specimens in the American Museum of Natural History suggested to Koopman (1979) that *stresemanni* might be properly regarded as a subspecies of *R. amplexicaudatus* while Rookmaaker & Bergmans (1981) in their comprehensive review of this species have synonymised *stresemanni* with *R. a. amplexicaudatus* (Geoffroy, 1810*a*).

Specimens recorded here from Papua New Guinea are large, corresponding closely with the original description of *stresemanni* by Stein. In size they also agree with specimens from Ihu reported by McKean (1972) and with those from New Guinea measured by Rookmaaker & Bergmans (1981). They are generally a little larger than six from Timor examined by Goodwin (1979) and are similarly near or exceed the upper size limits of Timorese specimens (including some of those seen by Goodwin) studied by Rookmaaker & Bergmans. Specimens from Timor may be assumed to be topotypical or nearly so of *R. a. amplexicaudatus,* described originally from that island. The dimensions given by Rookmaaker & Bergmans for examples from New Guinea are likewise generally a little greater than those for specimens from Timor and its associated islands.

External measurements of 4♂♂ and 1 ♀, with cranial measurements of 2♂♂ and 1 ♀: length of forearm 85·8–90·4, 85·5; greatest length of skull 38·6, 39·4, 38·8; condylobasal length 36·8, 37·0, 37·5; condylocanine length 35·6, 35·8, 36·0; length front of orbit to tip of nasals 13·1, 13·0, 13·1; length palation to incisive foramina —, 17·5, —; least interorbital width 8·6, 8·3, 8·3; least postorbital width 7·5, 7·6, 8·3; zygomatic width 24·7, 24·0, 22·3; width of braincase 15·4, 15·6, 15·4; mastoid width 14·6, 14·1, 14·4; greatest width c^1–c^1 7·1, 7·4, 7·6, c^1–c^1 (alveoli) 6·7, 6·9, 7·0; m^2–m^2 (alveoli) 10·2, 10·3, 10·8; c–m^2 13·5, 13·7, 14·0; length complete mandible from condyles 28·6, 28·3, —; length right ramus from condyle 30·1, 29·9, 30·0; c–m_3 15·1, 14·7, 15·6.

DISCUSSION. Rookmaaker & Bergmans (1981) have reviewed *R. amplexicaudatus* in detail, with a summary of earlier classification, synonymies, and many measurements derived from a relatively large number of specimens. These authors considered size to be the only major subspecific character in the species and recognised three size groups from the Solomon Islands, New Guinea, the Philippine Islands, Timor and Java. Of these, the smallest examples were found to occur on the Solomon Islands, the largest in New Guinea and the Philippines (these latter being mutually indistinguishable); specimens from Java, like those from the Solomons, proved significantly smaller than specimens from New Guinea and the Philippines. Examples from Timor were found to be generally a little larger than those from Java, but not significantly so, and a little smaller on the whole than those from New Guinea and the Philippines, although again the differences lacked significance. However, such specimens were thought by Rookmaaker & Bergmans to have a greater similarity to examples from New Guinea and the Philippines than to those from Java. On this basis they recognised three subspecies, *R. a. brachyotis* (Dobson, 1877*a*) from the Solomon and Bismarck Islands, *R. a. infumatus* (Gray, 1870) from Sumatra and Java east to Flores and possibly Alor Island,

and *R. a. amplexicaudatus* from Sumba Island, Timor and some smaller associated islands, New Guinea, possibly from the Molucca Islands, and from the Philippines. Specimens from Sulawesi were not allocated to subspecies: others from Borneo, Mentawei and Engano Islands, Malaya, Thailand and Burma were referred to *R. a. amplexicaudatus,* but few examples are available from the western part of the range. At the eastern limit, however, Smith & Hood (1981) have suggested that the population on the Bismarck Islands (*R. a. brachyotis*) is subspecifically separable from that on the Solomon Islands (*R. a. hedigeri* Pohle, 1953), although the distinction is less marked than the divisions between these island subspecies and *R. a. stresemanni* from New Guinea.

Considerations of relative size led Rookmaaker & Bergmans (1981) to associate specimens from Timor with those from New Guinea and thus to synonymise *stresemanni* with *R. a. amplexicaudatus.* However, their account of specimens from Sulawesi and some of its associated islands indicates that in some ways these unallocated examples are intermediate between *R. a. infumatus* and Timorese specimens of *R. a. amplexicaudatus.* A study of their detailed tabulated measurements for these populations confirms this view: also of two specimens (BM(NH) 98.11.3.20–21) from Alor Island provisionally allocated to *R. a. infumatus* by Rookmaaker & Bergmans the male is similar in size to males from Timor, but the female to females from Java. Rookmaaker & Bergmans also made a detailed examination of the relation between condylobasal length and zygomatic width in some of the populations of *R. amplexicaudatus.* Their diagrams show that while in these dimensions Timorese specimens lie in the lower part of the range of variation of those from New Guinea and the Philippines and are separated more distinctly from the Javanese population the limited Sulawesian sample tends to bridge this interval. It is also evident that the majority of specimens from New Guinea and the Philippines exceed Timorese and Sulawesian specimens in one or both of these dimensions. There seems, therefore, at least as much to justify the association of Timorese specimens (*R. a. amplexicaudatus*) with those from Sumatra, Java and the Lesser Sunda Islands (*R. a. infumatus*) as with those from New Guinea.

For these reasons *stresemanni* has been retained as a distinct subspecies in New Guinea and possibly also in the Philippine Islands. Measurements by Rookmaaker & Bergmans (1981) indicate that only small overall differences exist between these populations. Philippine females have longer wing elements than the very limited New Guinea sample examined and on the basis of a larger representation of females from New Guinea are cranially rather smaller on the whole but with longer toothrows. Until more specimens are available from the Molucca Islands, Sulawesi and the western part of the range of *R. amplexicaudatus* from Borneo and Sumatra to Burma it seems appropriate to regard *R. a. amplexicaudatus* as a valid link between the smaller *R. a. infumatus* and the larger *R. a. stresemanni.*

Rousettus celebensis Andersen, 1907

Rousettus celebensis Andersen, 1907*a*: 509. Mount Masarang, N Sulawesi, 3500 ft.

SPECIMENS EXAMINED. N Sulawesi: ♀♀BM(NH) 78.964–967 Tangkopo, Batuangus, near Bitung (in alcohol, BM(NH) 78.965 head, skin, others heads only; coll. A. M. Jones).

C Sulawesi: ♂♂ BM(NH) 81.1066–1068 Ganda Ganda, 1° 57′ S, 121° 21′ E; ♂ BM(NH) 81.1069 Sampalawa, 21 km from Kolono Dale, c. 2° 00′ S, 121° 20′ E: 5 ♂♂, 11 ♀♀ BM(NH) 81.1070–1085 R Ranu, 1° 51′ 121° 30′ E; 2♂♂ (yg.), 2♀♀ BM(NH) 81.1086–1089 Songinbau, 1° 46′ S, 121° 43′ E; 2 ♀♀ BM(NH) 81.1090–1091 Taronggo, 1° 44′ S, 121° 40′ E (all in alcohol; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. Andersen (1907, 1912) pointed out that this species had before then been confused with *R. brachyotis* (=*R. amplexicaudatus brachyotis*) and indeed earlier authors also referred specimens since recognised as *celebensis* to *R. amplexicaudicaudatus* or to *R.*

minor Andersen, 1907 (=*R. amplexicaudatus infumatus,* after Rookmaaker & Bergmans, 1981). Andersen's view (1912) that the alleged occurrence of *R. amplexicaudatus* (as *R. brachyotis*) in Sulawesi probably rested on confusion with *R. celebensis* may well have led to all *Rousettus* from that island being referred to the latter species, as Rookmaaker & Bergmans (1981) suggest. These authors record specimens of *R. amplexicaudatus* from Gorantalo and Talassa in Sulawesi and from the associated islands of Muna, Peleng and Talisai: those from Peleng were referred originally to *R. amplexicaudatus* by Tate (1942*c*). The two species may be distinguished by a number of features: *celebensis* has longer fur, a furred notopatagium and much more densely pilose tibiae while the rostrum is relatively longer with longer, more nearly parallel rather than convergent upper toothrows. The dentition also provides good diagnostic features: the last upper premolar (pm^4) is longer than in *amplexicaudatus* and the molars both above and below are distinctly narrow, the crowns of $m_{\frac{1}{1}}$ and m_2 clearly elongate, m_1 in particular being longer than in *amplexicaudatus.*

Rookmaaker & Bergmans (1981) reported and examined a total of 28 Sulawesian specimens (including BM(NH) 78.964–967) of *R. celebensis,* with 10 further examples from the Sanghir (=Sangihe) Islands and one from either the Talaud or Sanghir Islands: they do not include the holotype or two others listed by Andersen (1912). Among this material there is one extensive series, of 18 examples collected by G. Stein at Makassar. Specimens from 'Operation Drake' and others reported here therefore considerably extend the known representation of the species. They agree closely with the accounts by Andersen (1907, 1912): one, BM(NH) 81.1068 is unusual in lacking the right upper molar (M^2) and in having only four instead of six cheekteeth in the left lower jaw, there being no trace of the last two molars (m_2, m_3), while BM(NH) 81.1075 and BM(NH) 81.1091 are young adults with the last molars ($m_{\frac{2}{3}}$ yet to erupt. Length of forearm in 8 adult ♂♂ 71·8–76·9 (74·9); in 14 adult ♀♀72·5–80·2 (76·5). Males fall within the range of forearm lengths given by Rookmaaker & Bergmans (1981) for a slightly larger sample of male examples, but some females exceed the upper limit of the female specimens measured by these authors. Andersen (1912), who may have examined only dry skins, thought that the species might have a long tail, its length probably about 20 mm. The length of the tail in 8 ♂♂ is 23·5–27·5 (25·3) and in 14 ♀♀ 23·1–30·0 (27·1).

Discussion. I am unable to agree with Tate (1942*c*), who had seen only Andersen's description, that *celebensis* appears to be a member of the *amplexicaudatus* group, with narrower molars, and who in fact suggested that *celebensis* might be a subspecies of *R. amplexicaudatus* although listing it formally as a valid species. Koopman (1979) in discussing the status of *stresemanni* which he considers a subspecies of *R. amplexicaudatus* has pointed out that *celebensis* is distinct, an opinion fully endorsed by Rookmaaker & Bergmans (1981) who record both *amplexicaudatus* and *celebensis* from Gorontalo in N Sulawesi.

Andersen (1912) recognised three subgenera in *Rousettus,* placing both *amplexicaudatus* and *celebensis* in the nominate subgenus, distinguished by moderate deflection of the braincase, the last upper premolar (pm^4) not especially narrowed, its width about one third of the palatal width between the fronts of pm^{4-4}, the wing originating from the back of the first toe, and by a distinct antitragal lobe. In contrast, the subgenus *Stenonycteris* was defined by Andersen chiefly on the basis of a strongly deflected braincase, excessively narrow cheekteeth with the width of pm^4 about one fifth of the palatal width between the fronts of pm^{4-4}, wings originating from the back of the second toe and obsolete antitragal lobe.

In many respects *R. celebensis* approaches the African *R. lanosus* Thomas, 1906*a* apparently the sole representative of Andersen's subgenus *Stenonycteris.* It has similarly long, rather dense pelage extending on to the notopatagium, with long hairs on the forearms, tibiae, interfemoral membrane and the underside of the lateral membrane; long thumbs and long wings that tend towards those of the African species (wing indices of *celebensis* appear in Table 1); the wing is inserted at or near the rear of the second toe; a small, reduced, rounded antitragal lobe; the basicranial axis is somewhat deflected; the cheekteeth are gener-

Table 1 Wing indices (length of forearm = 1000) of 7 ♂♂ and 14 ♀♀ of *Rousettus celebensis*.

		Range	Mean
Thumb	♂♂	393–439	423
	♀♀	388–458	409
II^m	♂♂	444–480	458
	♀♀	427–471	446
II^1	♂♂	106–125	117
	♀♀	93–128	108
II^{2-3}	♂♂	116–142	133
(c.u.)	♀♀	110–142	128
III^m	♂♂	651–669	658
	♀♀	636–694	660
III^1	♂♂	455–469	462
	♀♀	438–474	455
III^2	♂♂	548–621	585
	♀♀	554–615	583
IV^m	♂♂	631–652	637
	♀♀	617–659	635
IV^1	♂♂	330–356	344
	♀♀	321–359	340
IV^2	♂♂	368–401	378
	♀♀	343–385	367
V^m	♂♂	623–651	639
	♀♀	615–645	637
V^1	♂♂	291–306	299
	♀♀	275–304	292
V^2	♂♂	333–355	348
	♀♀	325–352	321

ally long and narrow, and, as in *lanosus*, the molars have little cuspidation. Andersen (1912) considered that *celebensis* probably represented a modification of the *R. amplexicaudatus* type, but it seems more appropriate to include this Sulawesian species with *R. lanosus* in the subgenus *Stenonycteris* if this is to be recognised rather than in the nominate subgenus where Andersen originally placed it.

Pteropus hypomelanus macassaricus Heude, 1896

Pteropus macassaricus Heude, 1896 : 177, footnote, pl. 5, fig. 4. Makassar, S Sulawesi.

SPECIMENS EXAMINED. C. Sulawesi: ♂ BM(NH) 81.1092 Ganda Ganda, 1° 57′ S, 121° 21′ E; ♀♀ BM(NH) 81.1093–1096 1 km NE of Tandiondo, 1° 45′ S, 121° 17′ E (all in alcohol, all except BM(NH) 81.1092 heads only; coll. B. H. Gaskell, 'Operation Drake').

Pteropus alecto alecto Temminck, 1837

Pteropus alecto Temminck, 1837, 2 : 75. Menado, N Sulawesi.

SPECIMENS EXAMINED. C Sulawesi: ♂, 4 ♀♀ BM(NH) 81.1097–1101 1 km NE of Tandiondo, 1° 45′ S, 121° 17′ E (in alcohol, heads only; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. Musser *et al.*(1982) have demonstrated that among the several forms of *Pteropus* described or reported from Sulawesi *P. arquatus* Miller & Hollister, 1921 is in fact *Acerodon celebensis,* as are the specimens from the northern part of the island recorded originally by Tate (1942*c*) as *P. argentatus.* Others known from Sulawesi besides *P. hypomelanus macassaricus* and *P. alecto alecto* are *P. griseus mimus* Andersen, 1908, *P. caniceps dobsoni* Andersen, 1908 and *P. personatus* Temminck, 1825.

Pteropus conspicillatus Gould, 1850

Pteropus conspicillatus Gould, 1850 : 109. Fitzroy I, Queensland, Australia.

SPECIMENS EXAMINED. Papua New Guinea: ♂, ♀, ♀ juv. BM(NH) 80.525–527 Lababia Cave, Lababia I, Morobe, 7° 15′ S, 147° 09′ E (in alcohol, coll; B. H. Gaskell, 'Operation Drake').

REMARKS. Laurie & Hill (1954) listed *P. c. conspicillatus* from Papua New Guinea after Matschie (1899) who reported this subspecies from Bongu (5° 30′ S, 145° 50′ E) and Madang (5° 13′ S, 145° 48′E): a second subspecies, *P. c. chrysauchen* Peters, 1862 was listed from northwestern New Guinea after Tate (1942*c*) who recorded it from Geelvinck Bay.

These examples from Lababia Cave cannot be allocated positively to either of these subspecies. The adult ♂ BM(NH) 80.525 has a uniformly dark head, the forehead, crown and sides of the muzzle blackish, mixed especially on the forehead and on the muzzle anterior to the eyes with buffy hairs. Beyond a slight band of buffy hairs there is no indication of the paler eye rings characteristic of *P. c. conspicillatus* and the sides of the muzzle are not pale as in this subspecies. The adult ♀ BM(NH) 80.526, however, although predominantly black on the forehead, crown and cheeks has relatively distinct paler buffy eye rings and the sides of the muzzle above the mouth and the corresponding areas along the lower jaw are distinctly ochraceous buff. Moreover, the black of the crown extends forward as an acutely triangular patch whose apex intrudes between the pale superciliaries to the base of the rostrum. The adult male agrees therefore with *P. c. chrysauchen,* the adult female with *P. c. conspicillatus.* The collections of the British Museum (Natural History) include two further specimens (♂, ♀ 22.1.22.1–2) from Simbang, on the east coast of Papua New Guinea (probably at 3° 35′ S, 147° 43′ E) that are referable to *P. c. conspicillatus* although even in these the facial markings of the male are a little less pronounced than in the female example. Length of forearm in specimens from Lababia Cave (♂, ♀) 181, 179.

Styloctenium wallacei (Gray, 1866)

Pteropus wallacei Gray, 1866*a* : 65, fig. 1. Makassar, S Sulawesi.

SPECIMENS EXAMINED. C Sulawesi: ♀ (yg. ad.), ♂ BM(NH) 81.1102–1103 R Ranu, 1° 51′ S, 121° 30′ E (in alcohol); ♂ (yg. ad.) BM(NH) 81.1104 (in alcohol), ♀ BM(NH) 81.1105 (skin, skull, skeleton), ♀ (yg.) BM(NH) 81.1106 (in alcohol) Tambusisi Damar, Mt. Tambusisi, c. 4000 ft, 1° 39′ S, 121° 22′ E (all coll. B. H. Gaskell, 'Operation Drake').

REMARKS. Although this distinctive bat is by no means common in collections there is a number of records (Jentink, 1883; Matschie, 1899; Andersen, 1912) from N Sulawesi and Tate (1942*c*) has reported a long series from Malenge in the Togian Islands in the Gulf of Gorantalo. There is also a hitherto unreported specimen (♂ MZB 12671) from Titaeli, Minahassa, in the collections of the Museum Zoologicum Bogoriense, Bogor.

Adults obtained by Operation Drake display very clearly the badger-like white facial markings characteristic of the species: the white shoulder patches although always present are rather small in the two male examples, one not quite fully adult.

External measurements of an adult ♂ and ♀ (BM(NH) 81.1103, 81.1105): length of forearm 96·6, 95·5; thumb (c. u.) 43·2, 42·3; I^m 12·2, 12·0; I^1 23·7, 23·4; II^m 50·7, 51·5; II^1 12·4, 12·3; II^{2-3} (c. u.) 12·0, 11·3; III^m 69·0, 67·2; III^1 51·3, 51·4; III^2 69·0, 63·7; IV^m 69·4, 68·6; IV^1 39·7, 38·5; IV^2 40·6, 40·4; V^m 71·7, 71·8; V^1 31·4, 31·5; V^2 33·8, 33·9; tibia 42·4,—. Cranial measurements of an adult ♀ (BM(NH) 81.1105): total length of skull to gnathion 51·8; condylobasal length 48·5; condylocanine length 44·4; length front of orbit–tip of nasals 16·8; palatal length 28·0; length palation–incisive foramina 23·8; length palation–basion 18·3; lachrymal width 10·5; least interorbital width 6·8; least postorbital width 5·9; zygomatic width 28·3; width of braincase 19·7; mastoid width 17·9; orbital diameter 11·4; c^1–c^1 (crowns) 9·5, (alveoli) 8·8; m^1–m^1 (crowns) 13·9, (alveoli) 12·7; c^1–c^1 (internally, cingula) 5·1; pm^4–pm^4 (internally) 6·9; width of mesopterygoid fossa 7·4; c–m^2 19·1; length of complete mandible from condyles 36·4; length right ramus from condyle 38·1; coronoid height 19·8; c–m_2 19·9.

Dobsonia viridis (?) viridis (Heude, 1896)

Cephalotes viridis Heude, 1896 : 176, footnote, pl. 5, fig. 1. Kei Is.
Dobsonia viridis umbrosa Thomas, 1910*a* : 384. Ceram I.

Specimens examined. C Sulawesi: ♀, ♂ BM(NH) 81.1107–1108 R Ranu, 1° 51′ S, 121° 30′ E (in alcohol, skulls extracted; coll. B. H. Gaskell, 'Operation Drake').

Remarks. These are apparently the first of *viridis* to be reported from Sulawesi: it occurs otherwise on the Kei Islands and on the islands of Amboina, Buru, Ceram and Banda. Thomas (1910*a*) separated specimens from Ceram as *D. v. umbrosa* to which Andersen (1912) subsequently referred others from Buru and Amboina: this author (p. 825) remarked that the reference by Thomas to a number of specimens from 'Aru' is a misprint for Buru but in his personal copy of his paper, now in the Library of the British Museum (Natural History), Thomas has corrected Aru to Kei [Islands]. The collections in London include several specimens collected by W. Stalker on the Kei Islands but only a single immature from Buru, obtained by this collector. A small average difference in colour separates *umbrosa* from *viridis* of the Kei Islands and the two are synonymised in the listing by Laurie & Hill (1954). A closely related form, *D. crenulata* Andersen, 1909 occurs on the Halmahera group of islands to the northwest of New Guinea and has been reported recently from the Sanghir (=Sangihe) Islands and on the Togian Islands. It is separated from *D. viridis* chiefly on account of its greater size and larger teeth.

Specimens from Sulawesi have the characteristic dentition of the *viridis* group of Andersen (1909, 1912) in which m^1 has a well-developed antero-internal ledge and $pm\frac{4}{4}$ and $m\frac{1}{1}$ have cuspidate labial and lingual ridges. The surface cusps or ridges of $m\frac{1}{1}$ and m_2 are also strongly developed and prominent, of pm^4 much less so. The collector, B. H. Gaskell remarks of the coloration of the adult that when freshly obtained the dorsal pelage was a light dull green in hue, yellower towards the rear and flanks, with the upper surface of the head yellowy green grey, sharply divided on the neck from the colour of the body. The ventral surface was generally similar in colour to the lower back but medially light orange. The indefinite greenish tinge in the pelage appears characteristic of *D. viridis*: Goodwin (1979) also commented upon the unusual olive green colour of adults of *D. peronii peronii* (Geoffroy, 1810*a*) when living. The colour faded rapidly in specimens preserved as dry skins, in alcohol, or in formalin.

In size both Sulawesian examples are similar to or exceed the largest of Moluccan specimens of *viridis* and their cheekteeth, especially of the male, are generally longer and slightly larger, particularly pm^4, $m_{\frac{1}{2}}$ and m_2. To some extent, therefore, they approach *crenulata* but their canines are smaller and their cheekteeth generally narrower, like those of *viridis* from the Moluccas.

Measurements of an adult ♀ and ♂ (BM(NH) 81.1107–1108): length of forearm 113·5, 125·4; III^m 71·6, 77·1; IV^m 65·4, 70·0; V^m 66·2, 71·0; total length of skull to gnathion 48·2, 50·1; condylobasal length 46·2, 47·8; condylocanine length 45·7, 47·6; rostral length 15·6, 15·3; length front of orbit–tip of nasals 12·2, 11·9; palatal length 24·1, 25·0; length palation–incisive foramina 21·1, 22·1; length palation–basion 19·1, 19·6; lachrymal width 11·8, 11·6; least interorbital width 8·4, 8·2; least postorbital width 7·5, 6·4; zygomatic width 29·4, 31·1; width of braincase 19·7, 19·7; mastoid width 18·4, 18·3; orbital diameter 9·9, 9·9; c^1–c^1 (crowns) 9·3, 9·5, (alveoli) 8·7, 8·7; m^1–m^1 (crowns) 14·6, 15·1, (alveoli) 13·8, 14·4; m^2–m^2 (crowns) 12·8, 12·9, (alveoli) 12·5, 12·6; c^1–c^1 (internally, cingula) 3·4, 3·7; pm^4–pm^4 (internally, 7·6. 7·7; width of mesopterygoid fossa 6·0, 5·8; c–m^2 (crowns) 18·8, 19·8, (cingula) 18·4, 19·4; length complete mandible from condyles 36·5, 37·4; length right ramus from condyle 37·7, 38·9; coronoid height 20·3, 21·8; c–m_3 (crowns) 20·0, 20·7, (cingula) 19·8, 20·4. Length/width of: c^1 3·86/2·48, 3·82/2·54; pm^3 3·94/2·88, 4·02/3·22; pm^4 4·02/2·72, 4·32/3·14; m^1 5·15/2·44, 5·17/2·83; m^2 2·34/1·56, 2·37/1·61; c_1 2·64/2·17, 2·65/2·22; pm_2 1·40/1·34, 1·30/1·45; pm_3 3·72/2·31, 3·90/2·52; pm_4 4·02/2·53, 4·22/2·62; m^1 3·99/2·15, 4·21/2·35; m_2 3·30/2·08, 3·31/2·16; m_3 1·90/1·31, 1·85/1·43.

Discussion. The *viridis* group of *Dobsonia* as proposed by Andersen (1909, 1912) includes besides *D. viridis* and *D. crenulata* the further species *D. praedatrix* Andersen, 1909 from the Bismarck Archipelago and *D. inermis* Andersen, 1909 and *D. nesea* Andersen, 1909 from the Solomon Islands. Since Andersen wrote a number of changes have been made to this classification. Troughton (1936) regarded *nesea* as a subspecies of *D. inermis* while Rabor (1952) in describing *D. viridis chapmani* from Negros Island in the Philippine Islands treated *crenulata* as a further subspecies of *viridis*. Pohle (1953) considered *crenulata* and *praedatrix* to be subspecies of *D. viridis* and *inermis* (including *nesea*) probably so. Laurie & Hill (1954) retained the arrangement of Andersen but united *nesea* with *inermis* as a subspecies.

More recently, Bergmans (1975) discussed the *viridis* group in some detail, describing a further species, *D. beauforti* from Waigeo Island in the northern Moluccas, and rejecting the views of Rabor and Pohle. Since then he has (1978) examined the group yet further and has established that *chapmani* does not fulfil the appropriate diagnostic criteria but seems more likely to belong to the *moluccensis* group. Moreover, Bergmans is now of the opinion that *praedatrix* and *inermis* (including *nesea*) differ sufficiently from the two (sic) other species that they should form one or two species groups by themselves. *Dobsonia beauforti* is said to be morphologically allied to *D. viridis* but is appreciably smaller in forearm and skull measurements, in size much like *D. inermis* from the Solomon Islands. No specimens of *D. beauforti* have been examined.

Only the holotype (BM(NH) 60.8.26.2) of *crenulata* is available for study in London. However, De Jong & Bergmans (1981) have reviewed this taxon, recording it for the first time from the Sanghir (=Sangihe) Islands and from the Togian Islands, and have provided measurements of a number of specimens. These authors refer to earlier views (Rabor, 1952; Pohle, 1953) that *crenulata* is a large subspecies of *D. viridis,* but regard the union of the two into the same species as premature, since specimens of each sex from any one population are as yet insufficient to establish its range of size variation. The specimens from Sulawesi approach and in some respects equal *crenulata* in external and cranial dimensions, but on the whole have slightly narrower cheek teeth similar in width to those of *viridis*. They have smaller canines than the subadult holotype of *crenulata*, corresponding closely to those of *viridis*. This limited sample therefore suggests strongly that *viridis* and *crenulata* are likely to prove conspecific, a view provisionally adopted here.

Dobsonia praedatrix Andersen, 1909

Dobsonia praedatrix Andersen, 1909 : 532. Duke of York I, Bismarck Archipelago.

SPECIMENS EXAMINED. Bismarck Archipelago: ♀, ♂, ♀ BM(NH) 69.304–306 Kareeba Plantation, Keravat, New Britain, 4° 18′ S, 152° 01′ E (skins, skulls; coll. J. I. Menzies).

REMARKS. These relatively recently collected specimens confirm the diagnostic features used by Andersen (1909, 1912) in separating *praedatrix* from *viridis* and *crenulata*. As pointed out by Andersen, the rostrum is heavily built and is broader and more massive, with a considerably wider interorbital region. The teeth of the male example are similar in size to those of the holotype but in the female specimens are generally slightly smaller, overall much as the teeth of *viridis*. Andersen (1912) observed correctly that pm^4_4 in the holotype of *praedatrix*, however, are practically as large as in *crenulata* but in each of the specimens reported here these teeth are smaller than those of *crenulata* and are nearer in size to pm^4_4 of *viridis*. The labial and lingual longitudinal ridges of pm^4_4 and m_1 are faintly cuspidate in BM(NH) 69.305 but scarcely if at all cuspidate in BM(NH) 69.304 and 69.306. The longitudinal ridges of these teeth in the holotype are slightly more cuspidate, but the teeth are little worn. As in *viridis, crenulata* and in the holotype of *praedatrix* m_1 and m_2 have well developed surfacial cusps or ridges: the surface cusp of pm^4 is low and very undeveloped.

The three specimens closely resemble the holotype in colour. Dorsally, the shoulders and neck are brownish, strongly tinged with black in the male, the head blackish brown, this darker colour extending medially down the nape and neck in a narrow line; the ventral surface of the body is brownish drab, medially with a faint wash of brighter tawny olive, the underside of the neck and chin with a much sparser covering of longer, brownish hairs.

The male example is larger cranially than the two female specimens, adding support to Bergmans (1975) who suggested that sexual dimorphism in size might well occur in some at least of *Dobsonia*. Measurements of ♂ BM(NH) 69.305, ♀♀69.304, 69.306 in that order: length of forearm 116·3, 117·3, 112·2; total length of skull to gnathion 50·6, 48·3, 48·5; condylobasal length 47·6, 45·6, 45·5; condylocanine length 47·3, 45·2, 45·0; length front of orbit–tip of nasals 14·5, 13·3, 13·1; palatal length 25·5, 23·7, 24·2; length palation–incisive foramina 22·6, 21·7, 21·7; length palation–basion 19·1, 18·8, 18·5; lachrymal width 13·8, 12·8, 12·9; least interorbital width 10·1, 9·7, 10·0; least postorbital width 8·2, 7·7, 7·9; zygomatic width 31·4, 30·0, 30·4; width of braincase 20·4, 19·4, 19·6; mastoid width 19·0, 17·8, 17·8; orbital diameter 10·8, 10·8, 10·6; c^1–c^1 (crowns) 9·7, 9·4, 9·4, (alveoli) 9·2, 8·8, 8·8; m^1–m^1 (crowns) 15·5, 14·7, 14·1, (alveoli) 14·7, 14·0, 13·5; c^1–c^1 (internally, cingula) 4·0, 4·1, 3·9; pm^4–pm^4 (internally) 8·0, 7·8, 7·5; width of mesopterygoid fossa 5·8, 5·9, 5·5; c–m^2 20·0, 18·4, 18·5; length complete mandible from condyles 37·8, 36·0, 36·0; length right ramus from condyle 39·2, 37·2, 37·5; coronoid height 21·6, 21·7, 21·6; c–m_3 21·1, 19·2, 19·3. Length/width of cheekteeth: pm^3 4·41/3·08, 4·04/2·81, 4·06/2·84; pm^4 4·22/3·14, 3·97/2·82, 3·95/2·83; m^1 5·31/2·74, 4·73/2·61, 4·70/2·72; m^2 2·45/1·64, 2·06/1·49, 2·15/1·42; pm_2 1·39/1·55, 1·13/1·43, 1·24/1·44; pm_3 4·09/2·61, 3·87/2·39, 3·84/2·32; pm_4 4·42/2·78, 3·89/2·48, 4·01/2·46; m_1 4·14/2·46, 3·60/2·21, 3·91/2·20; m_2 3·31/2·37, 2·98/2·02, 2·96/2·01; m_3 1·95/1·55, 1·79/1·46, 1·60/1·33.

DISCUSSION. Examination of these adult examples confirms that Bergmans (1975) correctly rejected the suggestion by Pohle (1953) that *praedatrix* should be allied subspecifically to *D. viridis*, but I am less convinced that it should be removed from the *viridis* group as the former author (1978) has since suggested. If dental characters are to remain the chief criteria by which the species of *Dobsonia* are classified, then *praedatrix* must be included in the *viridis* group as Andersen (1909, 1912) envisaged it, except that the degree of cuspidation of the longitudinal ridges of pm^4_4 and m_1 is less than is general in the group or is sometimes virtually absent. In this respect *praedatrix* approaches the *peronii* group of Andersen (loc. cit.) in which these ridges are simple, but m^1 reputedly lacks the well marked antero-internal basal ledge characteristic of the *viridis* group. The limited material of *D. peronii* in London

indicates that in this species m^1 has at least a small antero-internal ledge and that the character may not be as emphatic as Andersen implied, although the ledge is much more developed in *D. viridis* and its allies. As Bergmans (1978) suggested, *D. peronii,* by current classification the sole member of the *peronii* group, may be more closely related to the *viridis* group than to any other but as this author pointed out, *D. peronii* differs from *D. viridis* and from its allies in the outline of the rostrum, which is lower, relatively longer and curves downward less abruptly from the braincase. Bergmans also remarked that within the *viridis* group *peronii* comes closest to the *viridis-crenulata-beauforti* (sub)group (sic) but dentally it seems to approach more closely to *praedatrix.* The greenish coloration of *D. viridis* when alive also appears in *D. peronii peronii* according to Goodwin (1979).

Bergmans (1978) advanced the opinion that the inclusion of *praedatrix* from the Bismarck Archipelago and *inermis* (including *nesea*) from the Solomon Islands in the *viridis* group indicated a disregard of zoogeographical considerations. I find no conviction in this assertion since the group as presently constituted occupies the arc of islands to the west, northwest, north and northeast of New Guinea, perhaps without interruption since some remain zoologically poorly known. A biogeographic model of this nature was suggested by Smith & Hood (1981). Indeed, if *D. peronii* is regarded as a member of the *viridis* group it then includes a succession of island species and subspecies extending from Nusa Penida (near Bali) in the west to the Solomon Islands in the east, but apparently excluding New Guinea.

These considerations suggest that the *peronii* and *viridis* groups of Andersen (1909, 1912) might be merged to form a *peronii* group that includes *D. peronii, D. viridis* and its close allies, *D. praedatrix* and *D. inermis.* It can be summarized:

D. peronii grandis Bergmans, 1978	Nusa Penida I, Sumbawa I.
D. peronii sumbana Andersen, 1909	Sumba I.
D. peronii subsp. (see Bergmans, 1978)	W. Flores I, Alor I, Wetar I, Babar I.
D. peronii peronii (Geoffroy, 1810*a*)	Timor I.
D. viridis (?) *viridis* (Heude, 1896)	Sulawesi, Amboina I, Buru I, Ceram I, Banda Is, Kei Is.
D. viridis (?) *crenulata* Andersen, 1909	Rau I, Morotai I, Halmahera I, Ternate I, Batchian I, Togian Is, Sanghir (=Sangihe) Is.
D. beauforti Bergmans, 1975	Waigeo I.
D. praedatrix Andersen, 1909	New Britain, New Ireland, Duke of York I.
D. inermis nesea Andersen, 1909	N and WC Solomon Is: Shortland, Alu, Ghizo, Rubiana, Bougainville, New Georgia.
D. inermis inermis Andersen, 1909	S and EC Solomon Is: San Christoval, Ugi, Ysabel, Rennell.

Phillips (1968) considered *nesea* a synonym of *inermis*, but McKean (1972) retained it as a valid subspecies on the basis of Troughton's (1936) assertion that *inermis* is darker in colour.

The occurrence of *D. viridis* in Sulawesi and (as *crenulata*) on the Togian and Sanghir Islands also has some bearing on Bergman's (1978) view of possible former distribution routes for *Dobsonia* towards the Lesser Sunda Islands. He suggested that *D. peronii* and *D. moluccensis* or their ancestors in these islands (there is only one local record of the latter, from Semau (=Samoa) Island, near Timor) might have originated from New Guinea (*moluccensis*) or from the Aru, Kei or Timorlaut Islands (*peronii*), possibly moving along

former land bridges, or alternatively along a more northerly route through the southern Moluccas and Sulawesi. A species of the *moluccensis* group, *D. exoleta,* has been known from Sulawesi for many years and Bergmans pointed out that the concept of the more northerly route implied that it is the closest living relative of *D. peronii,* although he considered *exoleta* to be less closely related to *peronii* than to the members of the *viridis* group. If Bergman's views are accepted the presence of *D. viridis* in Sulawesi resolves this apparent paradox.

Dobsonia moluccensis moluccensis (Quoy & Gaimard, 1830)

Hypoderma moluccensis Quoy & Gaimard. 1830.1 : 86, Atlas, pl. 11. Amboina.

SPECIMENS EXAMINED. Molucca Is: BM(NH) 75.2140 Lihura limestone caves, near Ruhuwa, SC Ceram I (crania, mandible, fragments, teeth; coll. R. F. Ellen).

REMARKS. This cave material compares favourably with *D. m. moluccensis* from Buru, Amboina and Ceram. Length of c–m^2 (alveoli) in two examples 23·1, 23·5.

Dobsonia moluccensis magna Thomas, 1905

Dobsonia magna Thomas, 1905*a* : 423. Tamata, Mambare R, Papua New Guinea, 100 ft.

SPECIMENS EXAMINED. Papua New Guinea: ♀ BM(NH) 69.307 Brown R, near Port Moresby, c. 9° 27′ S, 147° 08′ E; ♂ BM(NH) 69.308 Tupuselaia (= Tupuselei), 9° 33′ S, 147° 19′ E (both skins, skulls; coll. J. I. Menzies): ♂ BM(NH) 73.1969 Kairiru Ridge, centre of Kairiru I, near Wewak, East Sepik, c. 2000 ft; ♂ BM(NH) 73.1970 Victoria Bay, NW end of Kairiru I (both in alcohol; coll. Aberdeen University Exploration Society Expedition to New Guinea, 1973); BM(NH) 78.202–209 ? Near Mt. Hagen, Western Highlands (crania, damaged); BM(NH) 78.210–211 Baiyer R, Western Highlands (mandibles, damaged); BM(NH) 78.212–249 Tuman, Kubor Range, Western Highlands (crania, damaged); BM(NH) 78.250–255 Upper Lai Valley, Southern Highlands (crania, mandibles, damaged); ♀ BM(NH) 78.854 About 10 km S of Madang (in alcohol); ♂ BM(NH) 78.855 About 10 km S of Madang, c. 40 m (skin); ♂ BM(NH) 78.856 Baiyer R, c. 50 km NW of Mt. Hagen, Western Highlands, 1300 m (in alcohol) (all coll. P. A. Morris); BM(NH) 79.2015 (skin), BM(NH) 78.3004 (skull) Haelaelinga Settlement, on Was (= Wage) R, Nipa, Southern Highlands (coll. P. Sillitoe); ♂, ♀ BM(NH) 80.528–529 Buso, Morobe, 7° 17′ S, 147° 08′ E (in alcohol; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. The cranial and mandibular material BM(NH) 79.202–255 was obtained from kitchen middens: most show signs of heating or burning. The rear of the cranium in such specimens has been broken open to allow the extraction of the brain, a circumstance noted by Menzies (1977) of material from similar accumulations at the Kiowa and Yaku rock shelters.

Dobsonia exoleta Andersen, 1909

Dobsonia exoleta Andersen, 1909 : 531, 533. Tomohon, Minahassa, Sulawesi.

SPECIMENS EXAMINED. C Sulawesi: ♂ BM(NH) 81.1109 Ganda Ganda, 1° 57′ S, 121° 21′ E (in alcohol, skull extracted); ♂ BM(NH) 81.1238 Tapu Waru, 1° 51′ S, 121° 22′ E (in alcohol) (both coll. B. H. Gaskell, 'Operation Drake').

REMARKS. The relatively unworn dentition of BM(NH) 81.1109 agrees closely with the holotype (BM(NH) 99.10.1.4) and with the account by Andersen (1912). The antero-internal corner of pm^4 is developed into a conspicuous ledge with elevated rim; centrally the ledge is raised into a small cusp; pm^3 has a similar, narrower ledge; the antero-internal corner of m^1 is

low and platform-like but little differentiated except by a shallow antero-internal notch in the longitudinal ridge; a slight antero-internal basal ledge in pm_3, rather more developed in pm_4; m_1 with simple lingual ridge, no trace of an antero-internal ledge or cusp. There is a well developed posterior basal ledge on pm^3, a similar but slightly narrower ledge on pm^4; pm_3 has likewise a slightly wider posterior basal ledge than pm_4. Median surface cusps or ridges are well developed in m_1^1 and m_2, in the latter the ridge extending uninterruptedly through the length of the tooth; there is a low surface cusp on the posterior face of pm^4 that is absent from the more eroded dentition of BM(NH) 81.1238.

Measurements (♂ BM(NH) 81.1109, ♂ 81.1238, skull of 81.1109): length of forearm 116·8, 116·7; total length of skull to gnathion 51·7; condylobasal length 49·9; condylocanine length 49·8; length front of orbit–tip of nasals 14·4; palatal length 25·8; length palation–incisive foramina 23·4; length palation–basion 20·8; lachrymal width 12·4; least interorbital width 8·4; least postorbital width 7·0; zygomatic width 31·8; width of braincase 20·3; mastoid width 19·5; orbital diameter 11·1; c^1–c^1 (crowns) 10·5, (alveoli) 9·7; m^1–m^1 (crowns) 16·9, (alveoli) 15·9; c^1–c^1 (internally, cingula) 4·1; pm^4–pm^4 (internally) 8·2; width of mesopterygoid fossa 6·1; c–m^2 22·0; length complete mandible from condyles 39·7; length right ramus from condyle 41·0; coronoid height 21·2; c–m_3 23·3.

Discussion. Dentally *D. exoleta* agrees with *D. moluccensis* from the Molucca Islands, New Guinea and from some of its associated islands rather than with *D. peronii* from the Lesser Sunda Islands. The Sulawesian species differs most conspicuously from *peronii* in its lack of differentiation of the antero-internal corner of m_1 into a distinct cusp or small ledge, the inner or lingual ridge of the tooth being perfectly simple and lacking any notch or division. Andersen (1912) drew attention to a number of similarities between *exoleta* and *D. pannietensis* (De Vis, 1905) from the Trobriand Islands, which he thought differed from *exoleta* only in smaller size and in the lack of surface ridging on m_1, so considering the two taxa closely related. Later, Thomas (1914*a*) in describing *D. anderseni* remarked that this form from the islands of Manus and Ruk in the Bismarck Archipelago was intermediate in size between *exoleta* and *moluccensis,* an opinion confirmed to some extent by Bergmans (1979) who has examined specimens from a number of other islands in the Archipelago. As in *pannietensis* the dentition of *anderseni* is like that of *moluccensis.* Laurie & Hill (1954) recognised *exoleta* as a distinct species but listed both *pannietensis* and *anderseni* as subspecies of *D. moluccensis.* More recently, De Jong & Bergmans (1981) reviewed known specimens of *exoleta* in some detail and considered it to be a distinct species related in dental morphology to *chapmani* Rabor, 1952 from the Philippines, *moluccensis, anderseni* and *pannietensis.*

Bergmans (1975, 1978, 1979) has discussed and re-examined *pannietensis* and *anderseni.* He concluded (1975, 1979) that both should be considered specifically distinct on account of their smaller size when compared with *D. moluccensis moluccensis* and *D. m. magna* but it is not clear to what extent they differ from each other. This author (1975) suggested that to consider all of these conspecific involved the acceptance of an exceptional size range within one species, although (1979) he has himself accepted a considerable range of size among specimens from the islands (Louisiades, D'Entrecasteaux, Trobriand, Woodlark) immediately to the east of New Guinea that he considers all referable to *pannietensis.* Examination of the measurements provided by Bergmans (1979) suggests that some at least of the specimens that he refers to *pannietensis* are similar in size to *anderseni*: indeed, they overlap the measurements given by this author (1975, 1979) for the latter, although admittedly sexual differences in size may be involved. Moreover, Koopman (1979) in recording specimens from some of the small islands (Karkar, Bagabag, Umboi) off northeastern New Guinea and from the Bismarck Archipelago suggested that populations intermediate between *magna* and *anderseni* are to be found on Karkar and Umboi. This author has since (1982) discussed the question in some detail and while retaining *anderseni* as a subspecies of *D. moluccensis* considered *pannietensis* specifically valid, at least until the genus is fully revised. Insufficient specimens are available in London to determine the matter definitively, but for the present I

am unconvinced that *anderseni* and *pannietensis* should be considered species distinct from *moluccensis*: Bergmans (1978) himself admits that both are more closely related to *moluccensis* than to other species of the genus.

Bergmans (1979) provided a brief discussion of *exoleta* and compared it with *D. moluccensis pannietensis,* drawing attention to a number of differences. Of these, the relatively narrower interorbital and postorbital regions of *exoleta* also separate it (in the limited sample available) from *D. m. anderseni, D. m. magna* and *D. m. moluccensis.* For the present, therefore, I retain it as a distinct species and agree with Andersen (1912) in regarding it as the Sulawesian representative of the *moluccensis* group. The species is known to occur (De Jong & Bergmans, 1981) on Sulawesi, on the Togian Islands (Malenge) in the Gulf of Gorantalo, and on Muna Island.

Dobsonia minor (Dobson, 1879)

Cephalotes minor Dobson (1878), 1879 : 875. Amberbaki, NW New Guinea.

SPECIMENS EXAMINED. Papua New Guinea:♀♀ BM(NH) 73.1971–1973 Rauit, 3° 36′ S, 142° 15′ E (in alcohol); BM(NH) 74.337–338 Near Rauit (skulls) (all coll. Aberdeen University Exploration Society Expedition to New Guinea, 1973).

Cynopterus brachyotis brachyotis (Muller, 1838)

Pachysoma brachyotis Muller, 1838 : 146. R Dewei, Borneo.

SPECIMENS EXAMINED. Burma: 3 ♂♂, 4 ♀♀ BM(NH) 78.64–70, ♀♀ BM(NH) 78.151–153 British Embassy Residence Compound, Rangoon (in alcohol; coll. D. W. & G. Walton).

N Sumatra: ♂♂, ♀ BM(NH) 81.675–677 Bohorok R, near Bukit Lawang, Langkat Reserve, Gunung Leuser Reserve complex (in alcohol; coll. R. Aveling).

S Sumatra: ♂♂ BM(NH) 78.1114–1115 Banda hurip, Pulas District, S Lampong; (?), ♀ BM(NH) 78.1116–1117 Asahan, Jabung District, Lampong; ♀ BM(NH) 78.1118 Lebung Dadup, Asahan, Jabung District, Lampong; ♀ BM(NH) 78.1119 Sukaraja tiga, Sukadana District, Lampong; ♂ BM(NH) 78.1120 Pring Kumpul, Pring Sewn District, Lampong; ♂♂ BM(NH) 78.1122–1123 Air Nanigan, Pulau Penggung District (all skins, skulls; presented by Museum Zoologicum Bogoriense).

N Sulawesi; ♂ (?), (?) BM(NH) 78.968–970 Tangkopo Batuangus, near Bitung (in alcohol; coll. A. M. Jones).

C Sulawesi: (?) BM(NH) 79.2333–2337 Shore of Lake Matano, c. 5 km W of Soroako (in alcohol, very bad condition; coll. P. Holmes); 21 ♂♂ (2 yg.), 10♀♀, neonate BM(NH) 81.1006–1036, R Ranu, 1° 51′ S, 121° 30′ E: 2 ♂♂, 5 ♀♀ (2 yg.) BM(NH) 81.1037–1044 Ganda Ganda, 1° 57′ S, 121° 21′ E (all in alcohol; coll. B. H. Gaskell, 'Operation Drake').

Banggui Archipelago: ♂ BM(NH) 81.1045 Potil Besar 1; ♂♂ BM(NH) 81.1046–1048 Kelara, Besar 1 (all in alcohol; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. Although *C. brachyotis* is a relatively commonly collected bat in southeastern Asia these specimens are of especial interest since those from Rangoon appear to be the first recorded from Burma and the furthest west the species has been reported on the Asian mainland while there have been few previous records from Sumatra and Sulawesi. Specimens of *C. brachyotis* from southern Sumatra are from an area that proves to be of particular taxonomic interest when the status of its congeners *sphinx* and *titthaecheileus* is considered. In size all of these specimens agree well with the extensive representation of *C. b. brachyotis* in the British Museum (Natural History) which suggests a range of forearm length of 57–66 for this subspecies over its range from Burma and Indochina to Sumatra and Sulawesi. Specimens from southern Sumatra with length of forearm 61·0–65·7 and m^1–m^1 (crowns) 8·2–9·0 approach the weakly defined subspecies *C. b. javanicus* Andersen, 1910 from Java but fall within the limits given by this author for *C. b. brachyotis.*

DISCUSSION. *Cynopterus minor* Revilliod, 1911. The status of this nominal taxon must remain uncertain for the present. It is known so far apparently only from the holotype from Lambuja, SE Sulawesi, a small individual with a forearm length of 53 that may be a young adult or unusually small example of *C. brachyotis*. It seems unlikely, however, that Revilliod should fail to recognise it as such.

In addition the name *minor* poses an involved nomenclatorial problem. It was proposed by Lyon in 1908 as *Niadius minor* for the taxon subsequently recognised as the Sumatran representative of *Cynopterus horsfieldi* by Andersen (1912) who considered *Niadius* Miller, 1906 a synonym of *Cynopterus*. As a result, Andersen (1912 : 827) regarded *Cynopterus horsfieldi minor* (Lyon, 1908) to be preoccupied by the combination *Cynopterus (Cynonycteris) minor* used by Trouessart (1878) for the species otherwise known as *Rousettus minor* (Dobson, 1873*a,b*), as it is today. In rejecting *minor* of Lyon, 1908 on this account Andersen proposed *Cynopterus horsfieldi lyoni* in its place, a substitute that subsequently (Robinson & Kloss, 1918, 1919; Chasen, 1940) came into use. Hill (1961*a*) reviewed the circumstances surrounding this situation and on the basis of verbal advice in 1960 from the International Commission for Zoological Nomenclature that secondary homonyms are not to be permanently rejected concluded that since *Cynopterus (Cynonycteris) minor* as used by Trouessart referred to a *Rousettus* the name *minor* as proposed by Lyon in 1908 should become again the valid subspecific epithet for the Horsfield fruit bat of Sumatra and Malaya.

However, the current International Code of Zoological Nomenclature provides (Art. 59, (b), (i)) that a junior secondary homonym rejected before 1961 is permanently rejected and cannot be restored unless the employment of the replacement name is contrary to existing usage. Thus *Cynopterus horsfieldi lyoni* Andersen, 1912 must become the valid name for the Sumatran and Malayan representatives of *C. horsfieldi*. At the same time the Code (Art. 59, (b), (ii)) states that if the secondary homonymy has been overlooked or the junior name not replaced, and the taxa in question are no longer congeneric, the junior name is not to be rejected, even though one name was originally proposed in the current genus of the other. Therefore *Cynopterus minor* Revilliod, 1911, having by these rulings no competitor within *Cynopterus* (*minor* of Lyon, 1908 having been rejected and replaced by *lyoni* of Andersen, 1912) remains a valid name in this genus, and is unaffected by the combination *Cynopterus (Cynonycteris) minor* used by Trouessart (1878).

Cynopterus sphinx angulatus Miller, 1898

Cynopterus angulatus Miller, 1898 : 316. Trang, S Thailand.

SPECIMENS EXAMINED. S Sumatra: ♀♀ BM(NH) 78.1112–1113 Wai Miring, Kota Agung District, Lampong; ♂ BM(NH) 78.1121 Pring Kumpul, Pring Sewn District, Lampong; 5♂♂, 2 ♀♀ BM(NH) 78.1124–1130 Air Naningan, Pulau Panggung District (all skins, skulls; presented by Museum Zoologicum Bogoriense).

Krakatau 1, 6° 10′ S, 105° 26′ E: ♂ BM(NH) 74.240 (in alcohol, skull extracted; coll. G. Lincoln).

REMARKS. Hill & Thonglongya (1972) discussed the affinities of *angulatus* and considered it to be a subspecies of *C. sphinx* (Vahl, 1797) rather than of *C. brachyotis* with which (after Andersen, 1912) it had been previously associated by the majority of authors. According to Andersen (loc. cit.) *angulatus* occurs as far to the northwest as northern Burma and Assam: however, a much wider representation of *C. sphinx* from Burma and Thailand than was available to Andersen suggests that Burmese specimens (length of forearm (24) 68·3–74·5) should be referred to the larger *C. s. sphinx* and that those from Thailand (length of forearm (12) 64·9–73·7) represent the slightly smaller *C. s. angulatus*. Dammerman (1938) records specimens from Krakatau Island and from the nearby island of Verlaten as *angulatus*, with which their size (length of forearm 69–72, greatest length of skull 30·3–33·2, c–m^1 10–11·2) clearly associates them. These islands apparently lie at the known limit of the southeastern extension of *C. sphinx* as it is understood here. A single specimen (BM(NH) 23.10.7.22) from

the island of Simalur, off the northwest coast of Sumatra is not *angulatus* as Thomas (1923*b*) recorded it but is an example of *C. horsfieldi* (Gray, 1843).

(?) Cynopterus sphinx pagensis Miller, 1906

Cynopterus pagensis Miller, 1906*b*: 62 North Pagi I, Mentawei Is.

SECIMENS EXAMINED. Siberut I, Mentawei Is: 2 ♂♂ (1 yg.) 2 ♀♀ BM(NH) 78.2914–2918 Base of Teitei Bulak, Sabeuleleu, Paitan R, off Saibi R; ♂ BM(NH) 78.2919 Near Tolailai, off Paitan R; ♂ BM(NH) 78.2920 Near Sibosua R, off Paitan R (all in alcohol, skulls of BM(NH) 78.2915–2920 extracted; coll. J. J. Whitten).

REMARKS. Specimens from Siberut Island average slightly larger in some respects (Table 2) than those from Sumatra. They may represent *pagensis,* which was synonymised with *angulatus* by Andersen (1912) but listed as a valid subspecies (of *C. brachyotis*) by Chasen (1940) (who included Siberut and Sipora I in the range of *pagensis*) on account of its apparently short ears when compared with *angulatus* and similarly retained by Tate (1942*c*) on grounds of darker colour. Two (BM(NH) 95.1.9.3–4) from Sipora were thought representative of *pagensis* by Andersen (loc. cit.) and are similar to those from Siberut. The Siberut specimens have relatively short ears (16·1–17·8) while the ears of the two from Sipora are rather longer (18·2–19·0). If this material in fact represents *pagensis* then as Andersen suggested this taxon is very close to *angulatus.* Specimens of *C. sphinx* from Krakatau and Verlaten Island also seem slightly larger than many Sumatran examples, but the sample size is small.

Cynopterus titthaecheileus titthaecheileus (Temminck, 1825)

Pteropus titthaecheileus Temminck, 1825 : 198, pl. 15, figs. 17, 19, 20. Buitenzorg, Java.

SPECIMENS EXAMINED. S Sumatra: ♂, ♀ BM(NH) 78.1106–1107 Bandan harip, Palas District, S Lampong; ♂ BM(NH) 78.1108 Relung Lelok, Natar District, S Lampong; ♂ BM(NH) 78.1109 Pring kumpul, Pring Sewn District, S Lampong; ♀ BM(NH) 78.1110 Air Naningan, Pulau Panggung District, Lampong; ♂ BM(NH) 78.1111 Gisting, Talang Padang District, Lampong (all skins, skulls; presented by Museum Zoologicum Bogoriense).

Krakatau I, 6° 10′ S, 105° 26′ E: ♀, 2 ♂♂ (1 imm.) BM(NH) 74.237–239 (in alcohol, skulls of BM(NH) 74.237–238 extracted; coll. G. Lincoln).

REMARKS. Specimens of *Cynopterus* here reported from S Sumatra and from Krakatoa are of considerable taxonomic interest. They fall clearly (in part from Krakatoa) into separate sympatric or near sympatric groups, corresponding to the taxa identified by Andersen (1912) as *brachyotis, angulatus* and *titthaecheileus.* Those of *titthaecheileus* from S Sumatra and Krakatoa average slightly smaller in some respects (Table 2) than *titthaecheileus* from Java but the differences are slight. They can be readily distinguished from *C. sphinx angulatus* (with which in three instances recorded here they occur) by their considerably larger size, relatively longer rostrum which is less markedly concave in dorsal profile, curving down less abruptly from the braincase, and their heavier canines. In turn *angulatus* although less characteristically larger than *brachyotis* (also recorded here sympatrically or nearly so with the other two taxa) has when compared with this smallest of the three forms a more rectangular, less tapered and more robust rostrum, with a longer palate that is generally wider, especially anteriorly, and larger, heavier cheekteeth. These three taxa I recognise as distinct species, namely *C. brachyotis (brachyotis), C. sphinx (angulatus)* and *C. titthaecheileus (titthaecheileus).*

Andersen (1912) recorded both *C. brachyotis brachyotis* and *C. sphinx angulatus* from Krapoh, Deli-Bedagei in northeastern Sumatra but although this author also recorded *C. titthaecheileus* from Sumatra he had no sympatric occurrence of this large bat with either of

Table 2 Measurements of *Cynopterus* from south Sumatra, Siberut Island, and Krakatoa (numbers of specimens examined in parentheses).

	C. b. brachyotis S Sumatra	*C. s. angulatus* S Sumatra	*C, s,* (?) *pagensis* Siberut I	*C. titthaecheileus* S Sumatra	*C. s. angulatus* ♂♂ Krakatoa I	C. *titthaecheileus* ♂, ♀ Krakatoa I
Length of forearm	(9) 55·6–65·2	(10) 64·8–70·1	(5) 66·3–72·4	(6) 73·1–81·0	68·7, 68·2	75·1. 75·4
Condylobasal length	(8) 26·4–28·5	(10) 30·1–32·0	(3) 31·0–32·1	(6) 33·1–34·8	29·0, 30·0	34·3. 33·8
Condylocanine length	(9) 26·0–27·9	(10) 28·4–30·6	(3) 30·1–31·5	(6) 32·3–34·0	28·3, 29·4	33·5, 32·9
Palatal length	(8) 13·8–15·4	(10) 15·6–16·7	(4) 16·2–17·5	(6) 17·5–19·0	15·9, 16·6	18·9, 18·1
Least interorbital width	(9) 5·8–6·6	(10) 6·4–6·9	(4) 6·6–6·8	(6) 6·3–6·8	6·2, 6·9	6·4, 6·6
Least postorbital width	(9) 5·9–6·8	(10) 6·1–7·6	(4) 6·6–7·2	(6) 5·8–6·6	6·3, 6·8	6·8, 5·7
Zygomatic width	(9) 18·1–19·9	(10) 19·5–21·1	(4) 19·9–21·9	(6) 20·9–23·8	19·4, 20·4	22·3, 22·1
Width of braincase	(9) 11·7–13·0	(10) 12·7–13·8	(4) 12·8–13·4	(6) 13·6–14·9	12·7, 12·9	14·3, 13·9
c^1–c^1 (alveoli)	(9) 5·8–6·3	(10) 6·3–7·0	(4) 6·2–7·0	(6) 7·2–7·8	6·6, 6·8	7·3, 7·3
pm^4–pm^4 (alveoli)	(9) 7·3–8·0	(10) 8·1–8·7	(4) 8·1–8·5	(6) 9·0–9·6	8·0, 8·4	9·3, 9·3
m^1–m^1 (crowns)	(9) 8·3–9·3	(8) 9·3–10·1	(4) 9·0–10·0	(6) 10·3–11·6	9·1, 9·5	10·5, 10·8
m^1–m^1 (alveoli)	(9) 8·0–8·9	(9) 8·8–9·9	(4) 9·0–9·8	(6) 9·9–11·5	9·0, 9·4	10·5, 10·6
c–m^2	(9) 9·0–10·2	(9) 9·9–10·8	(4) 10·3–11·4	(6) 11·4–12·5	10·6, 11·1	12·2, 11·8
Length complete mandible from condyles	(9) 19·5–21·9	(10) 21·7–23·0	(3) 23·4–24·5	(6) 25·2–27·0	22·3, 22·4	25·9, 25·8
Length right ramus from condyle	(9) 20·5–22·7	(10) 22·7–23·9	(3) 24·1–25·5	(6) 25·9–28·4	23·3, 23·9	27·0, 27·0
c–m_3	(9) 10·0–11·7	(9) 11·2–11·8	(4) 11·6–12·5	(6) 12·9–13·7	11·6, 11·9	13·4, 13·4

the other two species. Dammerman (1938) while reporting *C. sphinx angulatus* from Krakatoa and Verlaten I also recorded a specimen of *C. titthaecheileus* from the nearby island of Sebesi.

Discussion. Andersen (1912) associated *titthaecheileus* with *C. sphinx* as a subspecies, notwithstanding that his arrangement of this part of the genus involved a wide geographical hiatus between *C. s. sphinx* in India, Burma and northern Thailand and *'C. s. titthaecheileus'* in Sumatra and Java. This author considered *angulatus,* which fills this gap, to be a subspecies of *C. brachyotis,* a circumstance leading him to the conclusion that sympatric subspecies of *C. brachyotis* of different geographic origins, namely *C. b. brachyotis* and *C. b. angulatus* were to be found in the Malay Peninsula and in Sumatra. Although initially challenged by other authors, notably by Kloss and by his colleague Robinson (Kloss, 1911, 1916, 1917, 1919, Andersen & Kloss, 1915, Robinson & Kloss, 1915*a*, 1915*b,* 1918) who thought that *angulatus* might more properly be considered a subspecies of *C. sphinx,* this concept prevailed until quite recently.

Chasen (1940) attempted to resolve the distributional dilemma created by Andersen by limiting *C. b. brachyotis* to Malaya, Sumatra, Borneo and some of the associated islands, *C. b. angulatus* to southern Thailand and its coastal islands, and to the Natuna and Anamba Islands. Thus this author envisaged a large form in the north of the Malay Peninsula, a smaller form occupying the rest of the area from northern Malaya to Borneo, Sumatra, and, as *C. b. javanicus* Andersen, 1910, to Java. Hill (1961*a*) followed the arrangement proposed by Chasen but pointed out that specimens in the British Museum (Natural History) indicated a much wider zone of intergradation in northern Malaya than Chasen envisaged. However, both views prove unacceptable since larger specimens with forearm 67·5–73 are found also in Sumatra and agree with the size range that Chasen gives for *'C. b. angulatus',* while small animals corresponding to *C. b. brachyotis* occur in Thailand (Hill & Thonglongya, 1972) and are here recorded as far west as Rangoon in Burma.

Hill & Thonglongya (1972) reviewed the history of *angulatus* and concluded from a study of the collections of the British Museum (Natural History) that little taxonomic significance could be given to the features used by Andersen (1912) to distinguish *C. sphinx* from *'C. brachyotis angulatus',* which he thought sympatric in Burma and northern Thailand. Consequently these authors regarded *angulatus* a subspecies of *C. sphinx*: indeed, specimens in London demonstrate that the large Indian *C. s. gangeticus* Andersen, 1910 and the slightly smaller *C. s. sphinx* from northeastern India and Burma merge in Burma and Thailand into the characteristically smaller *C. s. angulatus* which extends southward into the Malay Peninsula to Sumatra and possibly east to Borneo. Sody (1930) refers a specimen from Moerah Teweh, Montellat River, southeast central Borneo to *Cynopterus brachyotis angulatus*: his measurements, given in some detail because clearly he recognised the importance of the specimen agree closely with those of Sumatran examples ascribed to *C. sphinx angulatus,* of which there is as yet no published record from Java or from Sulawesi. The Sumatran and Javan *C. titthaecheileus* differs from both *C. sphinx sphinx* and *C. s. gangeticus* not only in its rather larger size, although large individuals of *gangeticus* are similar in size to the smallest of *titthaecheileus,* but also in having a much heavier, more robust skull with broader, higher and more substantial rostrum that is relatively longer. It differs similarly from *C. s. angulatus* but these distinguishing features are more pronounced when it is compared with this smaller form of *C. sphinx.*

Lack of material prevented Hill & Thonglongya (1972) from any detailed consideration of Sumatran *brachyotis, angulatus* and *titthaecheileus,* these authors following Andersen (1912) in treating the latter as a subspecies of *C. sphinx* and, by implication, regarding Sumatran specimens attributed to it as large examples of *C. s. angulatus.* Until recently, the collections in London contained only an immature skeleton from Sumatra referred to *titthaecheileus*: other early Sumatran records of this species apparently rest on Andersen (loc. cit.) who examined most, if not all of the specimens before then reported in the literature.

Cynopterus major Miller, 1960*b*, from Nias Island, off west Sumatra is listed by Chasen (1940) as a subspecies of *C. sphinx*. Its very large size (length of forearm 75·5–82·0) however, suggests that more probably it is a subspecies of *C. titthaecheileus*. Similarly, *C. sphinx terminus* Sody, 1940*b* from Timor is also a large form (length of forearm 75·2–83) but has a relatively compact skull (condylobasal length 30·2–32·2), with a stout but short rostrum (Sody, 1940*b*, Goodwin, 1979). On geographical grounds, however, it is more likely to represent *C. titthaecheileus*: its relatively small skull might well justify recognition as a distinct species.

The relevant species and subspecies of *Cynopterus* may be summarised:

Cynopterus brachyotis (Muller, 1838)	
C. b. ceylonensis Gray, 1870	Sri Lanka
C. b. brachysoma Dobson, 1871*a,c* (*andamanensis* Dobson, 1873*b*)	Andaman Is.
C. b. brachyotis (Muller, 1838)	S Burma to Vietnam, Malaya, Sumatra, Borneo and many small associated islands, Bawean I, Philippine Is, Talaud I, Sulawesi, Peleng I.
C. b. altitudinis Hill, 1961*a*	Malayan highlands.
C. b. minutus Miller, 1906*b*	Nias I, off W Sumatra.
C. b. concolor Sody, 1940*a*	Engano I, off W Sumatra
C. b. javanicus Andersen, 1910	Java, Madura I, Bali
C. b. insularum Andersen, 1910	Kangean I, Mata Siri I.
Cynopterus minor Revilliod, 1911	SE Sulawesi
Cynopterus archipelagus Taylor, 1934	Polillo I, Philippine Is.
Cynopterus sphinx (Vahl, 1797)	
C. s. gangeticus Andersen, 1910	C, NW India.
C. s. sphinx (Vahl, 1797)	Sri Lanka, peninsular and NE India, Burma
C. s. angulatus Miller, 1898	N Burma to S China, Hainan I, Vietnam, Langkawi I, N Malaya, Sumatra, Krakatoa I. Verlaten I, (?) Borneo.
C. s. scherzeri Zelebor, 1869	Car Nicobar I.
C. s. serasani Paradiso, 1971	Serasan I, Natuna Is.
C. s. babi Lyon, 1916	Babi I, near Simalur I, off W Sumatra.
(?) *C. s. pagensis* Miller, 1906*b*	Mentawei Is, off W Sumatra.
Cynopterus titthaecheileus (Temminck, 1825)	
C. t. titthaecheileus (Temminck, 1825)	Sumatra, Krakatoa I, Sebesi I, Java, Lombok I.
(?) *C. t. major* Miller, 1906*b*	Nias I, off W Sumatra.
(?) *Cynopterus terminus* Sody, 1940*b*	Timor I.

Megaerops (?) ecaudatus (Temminck, 1837)

Pachysoma ecaudatum Temminck, 1837 : 94. Padang, W Sumatra.

SPECIMEN EXAMINED. N India: ♀ BM(NH) 16.3.25.1 Pashok, Darjeeling, 3000 ft (skin, skull; coll. N. A. Baptista, Bombay Natural History Society's Mammal Survey of India, Burma and Ceylon).

REMARKS. This specimen is one of two originally reported from Pashok by Wroughton (1916) as *Cynopterus sphinx,* to which he referred two others from Tong Song, also in the

vicinity of Darjeeling. There is no record of these three remaining specimens in the British Museum (Natural History) and they are presumably in the collections of the Bombay Natural History Society. A further specimen, BM(NH) 16.3.25.2 from Gopaldhara, 17 miles W of Sonada Railway Station, SW of Darjeeling is unreported by Wroughton and without doubt represents *Cynopterus sphinx*.

There is no previous published record of *Megaerops* from further west than northern Thailand, whence *M. ecaudatus* was reported by Hill & Thonglongya (1972), the species extending otherwise to Malaya, Sumatra and Borneo. This Indian example is similar in many features to specimens from Chiangmai, northern Thailand (♂ BM(NH) 70.1440) and Vietnam (BM(NH) 26.10.14.13) but its upper incisors, upper canines and anterior lower premolars (pm_2) are a little more massive. The narial branch of the premaxilla is less attenuated in its upper part but is equalled in this respect by specimens from Pahang, Malaya. Specimens from India, northern Thailand and Vietnam are slightly larger in some respects than those from Malaya but the differences are small and the number of examples limited.

Hill & Boeadi (1978) drew attention to variation in rostral profile and outline in *M. ecaudatus*, indicating that in specimens from Thailand and Vietnam the rostrum is slightly shorter and less elevated anteriorly than in Peninsular and Bornean examples, the rostral profile sloping more gradually to the tip. These authors also found variation in the degree of lateral compression of the rostrum. The specimens from northern India, northern Thailand and Vietnam have a short, broad rostrum that is not markedly concave frontally: others from southern Thailand, Malaya and Borneo have a slightly longer rostrum with a rather more abruptly concave profile, the rostrum sharply compressed laterally to give its upper part distinctly and strongly concave lateral margins. A series from Pahang, however, tends to some extent to bridge this difference, some specimens (for example ♀♀ BM(NH) 60.734, 60.736) having rostra that are a little less abruptly concave in profile and less laterally compressed than in more extreme Peninsular or Bornean examples. For these reasons northern specimens are referred to *M. ecaudatus* with some hesitation.

Measurements (♀ BM(NH) 16.3.25.1, ♂ BM(NH) 70.1440 from Doi Pahompok, Fang District, Chiangmai, N. Thailand, c. 18° 43′ N, 98° 59′ E and ♀ BM(NH) 26.10.4.13 from Dak-to, Annam, Vietnam, in that order); length of forearm 60·5, 55·7, 59·9; greatest length of skull to gnathion 27·4, 26·9, 28·2; condylobasal length 26·7, 25·6, 27·4; condylocanine length 26·6, 25·7, 27·2; length front of orbit–tip of nasals 6·9, 6·5, 7·1; palatal length 13·9, 13·3, 14·1; length palation–basion 10·8, 10·6, 11·1; median depth of premaxillae 1·4, 1·5, 1·4; rostral height at front of c^1 5·0, 4·7, 4·7; rostral height at centre of pm^3 6·5, 6·3, 6·0; lachrymal width 9·6, —, 9·8; least interorbital width 5·2, 5·5, 5·7; least postorbital width 5·3, 6·3, 6·0; zygomatic width 17·8, 18·5, —; width of braincase 12·1, 12·2, 12·3; mastoid width 11·6, 11·7, 11·8; orbital diameter 8·1, 8·0, 7·9; c^1–c^1 (crowns) 6·0, 5·4, 5·5, (alveoli), 5·5, 5·1, 5·3; m^1–m^1 (crowns) —, 8·6, 8·3, (alveoli) 8·3, 8·5, 8·4; c^1–c^1 (cingula, internally) 2·7, 2·8, 2·6; pm^4–pm^4 (crowns, externally) —, 8·8, 8·4, (internally) —, 5·9, 5·3; width of mesopterygoid fossa 4·2, 4·0, 4·2; c–m^1 (crowns) 8·6, 8·5, 8·9, (alveoli) 8·3, 8·1, 8·5; length complete mandible from condyles 19·9, 18·9, 19·7; length right ramus from condyle 20·6, 20·0, 20·7; c–m_2 (crowns) —, 9·4, 9·8, (alveoli) 9·5, 9·3, 9·6.

Measurements of selected teeth (BM(NH) 16.3.25.1, 70.1440, 26.10.4.13): length i^2 0·56, 0·48, 0·51; width i^2 0·58, 0·41, 0·44; length i^3 0·53, 0·46, 0·46; width i^3 0·45, 0·35, 0·43; length c^1 (from front face) 1·98, 1·71, 1·82; width c^1 1·67, 1·39, 1·52; length pm_2 0·71, 0·70, 0·61; width pm_2 1·02, 0·87, 0·80.

Chironax melanocephalus (Temminck, 1825)

Pteropus melanocephalus Temminck, 1825 : 190, pls. 12, 16, figs. 3, 4. Bantam, Java.

SPECIMENS EXAMINED. N Sumatra: ♀♀ BM(NH) 81.678–679 Near Bukit Lawang, Bohorok R (Bohorok orang utan rehabilitation centre), Langkat Reserve, Gunung Leuser Reserve complex (in alcohol; coll. R. Aveling).

W Java: 3 ♂♂, 3 ♀♀ BM(NH) 78.1085–1088 (skins, skulls), BM(NH) 78.1089–1090 (in alcohol) Cibodas, Mt. Gede (presented by Museum Zoologicum Bogoriense).

SPECIMENS REPORTED BUT NOT EXAMINED. N Sulawesi: ♀♀ Zoologisch Museum, Amsterdam ZMA 21.638–639 Over an upper tributary of Sungei Mauk, Cagar Alam Dumoga, 960 m (in alcohol; coll. K. D. Bishop, F. G. Rozendaal and W. F. Rodenburg).

REMARKS. There are relatively few references to this species in the literature and for many years it was known only from the original material from Java, in the Rijksmuseum van Naturrlijke Historie, Leiden (Andersen, 1912). Thomas (1923*a*) reported a specimen (BM(NH) 23.1.2.2, a juvenile) from Nias Island, off west Sumatra, Chasen (1940) subsequently recording specimens from northern Sumatra and from Selangor, Malaya. More recently further specimens have been reported from Selangor by Hill (1961*a*) and Hill & Thonglongya (1972) have recorded others from Pahang, Malaya and from Nakon Sri Thamrat in southern Thailand. Finally, Hill (1974) provisionally referred a young adult from Sulawesi to this species, which does not appear to have been reported from Java since originally described by Temminck. Moreover, none of the specimens subsequently recorded from other parts of the Malaysian region appear to have been compared directly with Javan material. The additional specimens reported here are of some interest since those from Java enable such a comparison to be made, not only with Malayan but also with Sumatran examples. Additionally, Dr. W. Bergmans has provided details and measurements of two specimens from Sulawesi in the Zoologisch Museum, Amsterdam that he has identified as *C. melanocephalus.*

Andersen (1912) found the two 'cotypes' in the Rijkmuseum van Natuurlijke Historie to be so faded as to be unsuitable for description. According to Temminck (1825) 'The hairs on the back are of two colours, a yellowish white at the base and an ashy black at the tip; nape, top of the head and muzzle black; the hairs diverging from a common centre on the sides of the neck, serving probably to conceal an apparatus that secretes an odorous fluid. All of the other parts beneath are a yellowish white and dull; membranes a dark brown.'

Specimens from Java agree closely in pelage colour with the description by Temminck. Dorsally the hairs are whitish or slightly yellowish white at the base and for much of their length, and are tipped with dark brown or blackish brown; the nape and the head are a darker, more blackish tint, while the underparts are dull greyish white, tinged with yellow. As Temminck remarked, there is a radial tuft of hairs at the side of the neck: these hairs are greyish white throughout their length and are a little coarser in texture than the surrounding pelage. The tuft itself is usually slightly more obvious in male than in female specimens. A male example (BM(NH) 67.1488) in dry preservation from Pahang, Malaya is very similar in overall coloration to Javan specimens but the neck tufts are orange, while a female (BM(NH) 70.1441) from southern Thailand has a slightly less blackish head and is browner ventrally, the neck tufts less prominent than in the male from Pahang (Hill & Thonglongya, 1972) and less distinctly orange. One of the two females (BM(NH) 81.679) recorded here from Sumatra has quite well marked orange neck tufts but the other example has no obvious neck patches. In both the throat is white or creamy white. Other specimens from Pahang (BM(NH) 67.1484–1486), Trengganu (BM(NH) 75.1233) and Selangor (BM(NH) 60.865–878) in Malaya, also preserved in alcohol, confirm that the neck tufts or patches are generally less developed in females and indicate that they are not invariably orange or tinged with orange although inevitably some changes in colour have occurred through prolonged immersion. The young adult female (BM(NH) 73.1802) from southern Sulawesi provisionally referred to *C. melanocephalus* by Hill (1974) is a little paler dorsally than Javan specimens and is tinged with grey over the shoulders: the nape and head are dark greyish brown rather than black, and it has prominent white neck patches, the white extending to the throat. According to Dr. Bergmans one of the Sulawesian specimens (ZMA 21.639) in Amsterdam agrees in colour

with the description (Hill, 1974) of this specimen: the other (ZMA 21.638) is somewhat lighter on the head and back but may be subadult.

Wing indices (Table 3) for the Javan specimens are in broad agreement with those given by Andersen (1912) for the two 'cotypes' of *C. melanocephalus,* although not unexpectedly there is a greater variation in the lengths of the digital components than was found by this author in so limited a sample. The metacarpals of the third, fourth and fifth digits, the first and second phalanges of the third digit and the second phalanges of the fourth and fifth digits of examples from Java are generally relatively shorter than are those of specimens from Sumatra and from the Malayan mainland, the third metacarpal especially so. On the basis of the two 'cotypes' Andersen (loc. cit.) noted of the wing of *Chironax* when compared with that of the closely related genus *Balionycteris* that the metacarpals of the third, fourth and fifth digits were not lengthened (lengthened in *Balionycteris*) the second phalange of the third digit was subequal in length to its metacarpal (much shorter in *Balionycteris*) and that the second phalanges of the fourth and fifth digits were slightly but distinctly longer than the associated first phalanges of the same digits (shorter in *Balionycteris*). The Javan specimens tend to support these contentions: in Sumatran and Malayan specimens the metacarpals of the third, fourth and fifth digits are lengthened to approach the condition found in *Balionycteris* but the second phalange in each of these digits is also correspondingly lengthened to retain more or less the relative proportions of *Chironax.* Specimens from Sulawesi have similarly lengthened third, fourth and fifth metacarpals but the second phalange of the third, fourth digits and on occasion of the fifth digit is relatively shortened as in *Balionycteris.*

Cranially the Javan specimens are similar in structure and size to those from Malaya, with similar teeth, as have the specimens from Sumatra: the second upper premolar (pm^3) has a well-marked antero-external supplementary cusp and the third upper premolar (pm^4) is more or less rectangular as in Malayan specimens. The young adult (BM(NH) 73.1802 from Sulawesi thus differs from Javan examples in much the same ways as it was found to differ (Hill, 1974) from those from Malaya: in some respects the skull is a little smaller, its supra-orbital region is slightly more swollen and the postorbital processes a little more massively developed, while pm^3 lacks a well developed antero-external supplementary cusp and pm^4 is more rounded, dental features in which it also differs from the Sumatran specimens. Two points not mentioned in the account of BM(NH) 73.1802 are that the rear edge of the bony post-palate is slightly concave rather than straight or nearly so as in Javan and Malayan examples, and that one of the inner lower incisors (i_2) is missing. Dr Bergmans remarks that in both Sulawesian examples in Amsterdam pm^3 also lacks an antero-external supplementary cusp: possibly this feature will be found to characterise the Sulawesian population.

External measurements of six specimens (except where indicated in parentheses) from Java (BM(NH) 78.1085–1090), with those of two (BM(NH) 81.678–679) from Sumatra: length of forearm 42·8–45·7, 41·9, 42·3; III^m 27·7–29·8, 28·9, 29·2; III^1 20·9–22·0, 21·0, 21·4; III^2 25·8–28·2, 25·2, 27·5; IV^m 26·5–28·2, 26·9, 27·3; IV^1 16·1–17·2, 16·4, 16·7; IV^2 17·1–18·9, 16·8, 18·2; V^m 27·8–29·5, 28·0, 28·1; V^1 14·0–14·9, 15·0, 14·5; V^2 15·1–16·0, 14·8, 15·9; length of ear from opening (2) 9·9, 10·5, 10·4, 10·9; greatest width of ear (2) 7·6, 7·8, 7·8, 7·3; length of tibia (2) 16·1, 16·2, 16·0, 15·9; length of foot (c.u.) (2) 10·5, 10·9, 9·5, 9·4.

Wing measurements (by Dr W. Bergmans) of two specimens (ZMA 21.638–639) from Sulawesi: length of forearm 45·6, 45·6; III^m 32·0, 32·4; III^1 23·1, 23·7; III^2 23·3, 26·8; IV^m 30·8, 31·0; IV^1 18·2, 17·9; IV^2 15·2, 17·1; V^m 32·6, 32·4; V^1 14·6, 15·3; V^2 13·8, 15·5.

Cranial measurements of four specimens (except where indicated in parentheses) from Java (BM(NH) 78.1085–1088): greatest length of skull 21·9–23·3; condylobasal length (3) 21·5–22·3; condylocanine length 21·0–22·0; length front of orbit–tip of nasals 5·0–5·5; length orbit–nares 5·1–5·6; palatal length (3) 10·4–11·7; length palation–incisive foramina (3) 8·6–10·0; length palation–basion (3) 8·1–8·7; lachrymal width 6·0–6·3; least interorbital width 4·3–4·4; least postorbital width 4·6–5·3; zygomatic width 14·5–14·8; width of braincase 9·8–10·2; mastoid width 10·0–10·5; orbital diameter 5·6–6·0; c^1–c^1 (crowns) (3)

Table 3 Wing indices (length of forearm = 1000) of *Chironax melanocephalus* and *Balionycteris maculata* (modified from Hill, 1974).

	Chironax melanocephalus										*Balionycteris maculata*
	Java			Sumatra		Malay Peninsula		Sulawesi			Malaya, Borneo
No. of specimens	1[1]	1[1]	6[2]	1[3]	1[4]	1[5]	16[6]	1[7]	1[8]	1[9]	20
III^{m}	639	633	634–652	688	690	680	678–711	704	702	711	708–780
III^{1}	488	489	472–490	501	502	474	488–532	507	507	520	473–547
III^{2}	639	622	575–625	607	652	584	583–658	568	511	588	559–652
IV^{m}	616	578	606–623	640	648	629	617–676	640	675	679	693–738
IV^{1}	372	378	361–401	391	396	373	357–414	373	399	393	374–430
IV^{2}	419	422	381–419	401	429	400	395–443	360	333	375	340–415
V^{m}	639	622	628–659	668	663	667	659–704	708	715	711	706–762
V^{1}	337	322	321–353	358	343	318	328–358	319	320	335	329–363
V^{2}	349	344	330–355	356	377	363	339–382	317	303	400	317–354

[1]'Cotypes', from Andersen (1912); [2]BM(NH) 78.1085–1090; [3]BM(NH) 1981.678; [4]BM(NH) 1981.679; [5]BM(NH) 60.871, young adult; [6]BM(NH) 60.865–878 (in part), BM(NH) 67.1484–1486, BM(NH) 70.1441, BM(NH) 75.1233; [7]BM(NH) 73.1802, young adult; [8]ZMA 21.638; [9]ZMA 21.639.

4·4–4·5, (alveoli) (3) 4·1–4·2, (cingula, internally) (3) 1·9–2·2; pm^4–pm^4 (crowns) (3) 6·4–6·8, (alveoli) 6·1–6·6, (internally) (3) 3·8–4·1; m^1–m^1 (crowns) 6·1, 6·5, (alveoli) 6·1–6·4; width mesopterygoid fossa 3·1–3·3; c–m^1 (crowns) (3) 6·6–7·3; length complete mandible from condyles 15·1–16·3; length right ramus from condyle 16·1–17·2; coronoid height 7·6–8·7; c–m_2 (crowns) 7·5–7·9.

Thoopterus nigrescens (Gray, 1870)

Cynopterus marginatus var. *nigrescens* Gray, 1870 : 123. Morty (= Morotai) Island.
Cynopterus latidens Dobson, 1878 : 86. Morty (= Morotai) Island.

Specimens examined. C Sulawesi: ♀, 2 ♂♂ BM(NH) 81.1049–1051 R Ranu, 1° 51′ S, 122° 22′ E; 8 ♂♂, 6 ♀♀ BM(NH) 81.1052–1065 Tambusisi Damar, Mt. 4000 ft. 1° 39′ S, 121° 22′ E (in alcohol. BM(NH) 81.1054, 81.1056, 81.1058–1061, 81.1063–1064 heads only; coll. B. H. Gaskell, 'Operation Drake').

Remarks. There are few records of this long-haired cynopterine fruit bat which is known so far with certainty from Morotai Island and from Menado and Minahassa in northern Sulawesi. Its reported occurrence on Luzon Island in the Philippines is thought doubtful by Taylor (1934) although it may extend to the southernmost of these islands. Length of forearm in four examples 76·5–78·9.

Discussion. This large bat is similar in many respects to the relatively recently described genus *Latidens* Thonglongya, 1972 from southern India, which is almost identical in external form and colour and has a similarly long, strong rostrum. Dentally, however, *Latidens* approaches the Malaysian genus *Penthetor,* differing in the outline of m^1, which is more or less square and not wedge-shaped, and in the wider, rather more square outline of pm_4 and m_1. The latter teeth, however, also have a low surface cusp and in this respect approach *Thoopterus.* These and other features suggest that *Thoopterus* is represented in Malaysia by *Penthetor* as was thought by Andersen (1912) and in southern India by *Latidens.* The three genera can be readily distinguished from each other by the incisive dentition, *Thoopterus* having incisors $\frac{2}{2}-\frac{2}{2}$, *Penthetor* $\frac{2}{1}-\frac{2}{1}$, and *Latidens* $\frac{1}{1}-\frac{1}{1}$.

Aethalops alecto (Thomas, 1923)

Aethalodes alecto Thomas, 1923*a* : 251. Indrapura Peak, Sumatra, 7300 ft.

Specimens examined. W Java: ♂, ♀ BM(NH) 75.590–591 Cibodas, Mt. Gede, 1450 m, c. 6° 50′ S, 106° 44′ E (skins, skulls; presented Museum Zoologicum Bogoriense).

Remarks. Two subspecies of the small fruit bat *A. alecto* are recognised, *A. a. alecto* from the Malayan mainland and from Sumatra, and *A. a. aequalis* Allen, 1938*a* from Sabah and Sarawak. Their diagnostic characters are reviewed in part by Hill (1961*a,* 1966*a*), who also gave measurements. The species has not been formally recorded hitherto from Java but that island is included within its distribution by Honacki *et al.* (1982). These specimens cannot be referred definitively to either of the described subspecies. They are similar in most respects to *A. a. alecto* but have longer forearms and longer and more massive incisors, with the anterior lower premolar (pm_2) larger (about twice the crown area of the lower incisor (i_2) against one and one half times the crown area of i_2 in *A. a. alecto*) and more substantial. They differ more noticeably from *A. a. aequalis* in rather longer forearms, longer skull and toothrows, in slightly heavier incisors, with the inner upper incisors (i^2) distinctly shorter than the outer tooth (i^3), in having the lower canine rounded antero-internally, not especially flattened, in larger anterior premolars ($pm\frac{2}{2}$) with pm_2 in particular more massive (in *A. a. aequalis* it is about equal in crown area to i_2), the second premolars ($pm\frac{3}{3}$) less closely approximated to the

canines, pm^3 having a well developed anterior secondary basal cusp while pm_3 is rounded anteriorly, lacking any projecting vertical anterior ridge.

Measurements (BM(NH) 75.590, 75.591): length of forearm 50·3, 51·0; greatest length of skull —, 25·4; condylobasal length —, 24·8; condylocanine length —, 24·5; palatal length 13·3, 13·2; lachrymal width 6·8, 6·3; least interorbital width 5·4, 5·1; least postorbital width 5·6, 5·3; zygomatic width 16·1, 15·5; width of braincase 11·0, 10·2; mastoid width 11·6, 10·5; c^1–c^1 (crowns) 5·4, 5·1, (alveoli) 4·9, 4·5; pm^4–pm^4 (crowns) 8·0, 7·4, (alveoli) 7·5, 7·0; c–m^1 (crowns) 8·5, 8·1, (alveoli) 8·0, 7·7; length complete mandible from condyles 18·6, 18·2; length right ramus from condyle 19·4, 18·8; c–m_2 (crowns) 9·3, 8·8, (alveoli) 9·0, 8·6.

Javan specimens of *A. alecto* are clearly closely related to *A. a. alecto* from Malaya and Sumatra, (whence only the holotype appears to have been recorded) differing only in slightly greater size in some respects, in the greater length and size of the incisive dentition and in larger pm_2. The Bornean *A. a. aequalis* differs more from either *A. a. alecto* or from the Javan examples than these populations do from each other. It has long upper incisors (similar to those of the Javan specimens although slightly smaller) but i^2 is equal or nearly equal in length to i^3, the inner face of the lower canine opposite the incisor is flattened or even broadly but shallowly grooved, pm^3 lacks any well developed anterior secondary basal cusp and the anterior face of pm_3 is narrowly ridged from the cingulum to the tip of the tooth. For the present the subspecific designation of the Javanese specimens is left undecided, pending more material to establish clearly the limits of their variation.

Aethalops alecto aequalis Allen, 1938

Aethalops aequalis Allen, 1938 : 497. Lumu Lumu, Mt. Kinabalu, Sabah, 5500 ft.

SPECIMENS EXAMINED. Sarawak, Borneo: ♀♀ BM(NH) 78.590–591 Camp 2, Gunung Mulu, Melinau, 3° 49′ N, 115° 50′ E, 550 m (in alcohol; obtained Earl of Cranbrook, Royal Geographical Society Expedition to Mulu, 1978).

REMARKS. These specimens supplement earlier records of *A. a. aequalis* (summarised by Medway, 1977) all from the highlands of north and northeastern Borneo. They are, however, from a somewhat lower altitude than any previously obtained, the subspecies having not before been collected below some 3000 ft.

HARPYIONYCTERINAE

Harpyionycteris celebensis Miller & Hollister, 1921

Harpyionycteris celebensis Miller & Hollister, 1921 : 99. Gimpoe, C Sulawesi.

SPECIMENS EXAMINED. C Sulawesi: 2 ♂♂, 5 ♀♀ (2 yg.) BM(NH) 81.1150–1156 R Ranu, 1° 51′ S, 121° 30′ E (in alcohol, skulls of BM(NH) 81.1150–1151, 81.1153, 81.1155 extracted); 2 ♂♂(1 yg.) BM(NH) 81.1157–1158 Tambusisi Damar, Mt. Tambusisi, c. 4000 ft, 1° 39′ S, 121° 23′ E (BM(NH) 81.1157 in alcohol, 81.1158 skull only) (all coll. B. H. Gaskell, 'Operation Drake').

REMARKS. *Harpyionycteris celebensis* was said by Miller & Hollister (1921) to be like *H. whiteheadi* from the Philippine Islands but to have a conspicuous secondary cusp on each side (i.e. on the anterior and posterior faces) of the second upper premolar (pm^3) and to have molars with lower crowns and relatively higher cusps. Tate (1951) in a detailed evaluation of *Harpyionycteris* suggested that *celebensis* was probably no more than subspecifically related to *whiteheadi* but made no close comparison of their distinguishing features. This suggestion

was adopted by Laurie & Hill (1954) who considered *Harpyionycteris* monotypic, *celebensis* being listed as a subspecies of *H. whiteheadi.*

More recently, Peterson & Fenton (1970) have reviewed the specimens then known of *Harpyionycteris,* considering *celebensis* to be a distinct species on account of its shorter, broader upper canine which is less proclivous than in *whiteheadi* and has a much wider posterior cusp when viewed laterally, and also to some extent in the presence in *celebensis* of a well developed secondary cusp on the posterior flange of pm^3. These authors apparently had available two adult examples from Sulawesi, one the holotype of *celebensis.* The series reported here from Sulawesi suggests that there is a considerable degree of variation in these features: variation in dental patterns in this genus can be quite extensive, as Peterson & Fenton pointed out in relation to the upper molars of the series from Negros Island, Philippine Islands that they described as *H. whiteheadi negrosensis.*

The series from Sulawesi consists of three subadult or young specimens and six adults. As in the series from Negros Island examined by Peterson & Fenton, immature specimens have a rather more strongly deflected braincase than do mature examples, and have a wider postorbital constriction. These authors also found the lower incisors generally absent from specimens of *H. whiteheadi* that they examined, three of twelve examples having only one incisor (on one side only) all of the others lacking lower incisors. Two immatures and two adults of the series from Sulawesi have two small, slightly spatulate lower incisors tightly sandwiched between the anterior part of the canine bases: one immature and two adults have one lower incisor, in one example (BM(NH) 81.1155) placed to one side with some indication that the corresponding tooth on the other side has been lost, in the others more centrally situated; and in two adults lower incisors are lacking.

The upper canines of specimens from Sulawesi are less proclivous and are generally rather more massive but shorter than those of the holotype of *H. whiteheadi* although in some the difference in size is small. The posterior canine cusp is variable in size: in a minority of specimens the cusp is large and massive, lacking any definite point, like that of the specimen (AMNH 153590) illustrated by Peterson & Fenton (1970), but more frequently the cusp is more or less triangular with a definite point, like that of the specimen photographed by Tate (1951, figs 1–3). Although generally larger than the corresponding cusp in the holotype of *H. whiteheadi* it may be on occasion similar in size to its counterpart in that species or even slightly smaller.

The cuspidation of pm^3 varies considerably in this series. The tooth in lateral profile ranges from a relatively high crowned structure with small but well developed supplementary cusps on its anterior and posterior margins extending along about three quarters the length of the tooth to just beneath the tip of the main cusp through stages in which the cusps are lower, about halfway along the length of the tooth, or present only anteriorly, the posterior cusp represented only by a flexure of the margin of the tooth, absent anteriorly but present posteriorly, or both effectively absent, their presence indicated only by a faint curvature of the edge of the main cusp. The tooth as a whole is lower than in the holotype of *H. whiteheadi,* although similar in overall bulk.

The molar teeth do not seem to be especially low crowned or high cusped in relation to those of *H. whiteheadi,* and there is no great degree of variation in their cuspidation such as that noted by Peterson & Fenton in the series that they named *H. whiteheadi negrosensis* from Negros Island. Cranially, specimens from Sulawesi have the median part of the palate more deeply excavated and transversely arched than does the holotype of *H. whiteheadi,* a feature not mentioned by Peterson & Fenton for the Sulawesian examples that they examined. Tate (1951) remarked that the yellowish markings on the wings of *H. whiteheadi* might be significant but similar yellowish spots or blotches are to be found on the wings of specimens from Sulawesi.

The palate ridges of Sulawesian specimens are similar to those of Philippine examples as illustrated by Sanborn (1952) and illustrated and described by Peterson & Fenton (1970). There are five anterior undivided ridges and three divided posterior ridges: these latter are greatly variable and the central ridge of the three is sometimes reduced to small paired raised

swellings on each side of the median division, or tends to blend and merge with the first of the divided ridges. There is also an undivided ridge much more posteriorly situated near the rear edge of the palate.

External measurements of six adults: length of forearm 84·2–88·3; length of thumb (c. u.) 35·1–37·3; II^m 39·2–42·3; II^1 11·2–12·0; II^{2-3} (c. u.) 11·3–12·8; III^m 57·6–62·4; III^1 45·6–47·8; III^2 57·8–63·3; IV^m 54·0–58·5; IV^1 36·1–37·8; IV^2 35·3–37·5; V^m 55·9–58·3; V^1 28·9–31·3; V^2 32·7–35·7; length of tibia 29·2–29·5; length of foot (c.u.) 22·2–23·6.

Cranial measurements of four adults: greatest length of skull 41·2–42·0; condylobasal length 39·2–39·7; condylocanine length 39·0–39·6; length front of orbit–tip of nasals 10·4–11·5; palatal length 21·3–22·1; length of palation–incisive foramina 17·0–18·1; length palation–basion 15·7–16·4; lachrymal width 10·0–11·0; least interorbital width 6·4–7·0; least postorbital width 5·7–6·4; zygomatic width 23·4–24·1; width of braincase 15·7–16·7; height of braincase 13·3–14·3; mastoid width 14·6–15·6; orbital diameter 8·9–9·6; c^1–c^1 (crowns) 7·4–8·2, (alveoli) 6·8–7·4; (cingula, internally) 2·8–3·1; pm^3–pm^3 (crowns) 8·8–9·5; (alveoli) 8·3–9·1, (internally) 5·0–5·7; pm^4–pm^4 (crowns) 9·5–10·7, (alveoli) 9·1–10·3, (internally) 5·4–6·3; m^2–m^2 (crowns) 10·7–11·7, (alveoli) 10·6–11·6, (internally) 7·3–8·1; width mesopterygoid fossa 4·6–5·2; c–m^2 16·6–16·8; length complete mandible from condyles 31·5–32·3; length right ramus from condyle 32·4–33·9; depth mandible between pm_4 and m_1 4·0–4·5; depth mandible behind m_3 5·3–5·7; coronoid height 15·1–15·8; c–m_3 17·7–18·4.

Discussion. Peterson & Fenton (1970) present a persuasive argument for the recognition of *celebensis* as a distinct species, supported by morphological features drawn from the skull and dentition, by zoogeographical argument based on the considerable distance over open water separating Sulawesi from the nearest small islands that might serve as stepping stones from the Philippines and the separation of these islands from Sulawesi by Wallace's Line. They also base their view on the fact that the genus has not been recorded from Borneo which is less widely separated from Sulawesi at its point of closest approach (in fact Borneo lies on the other side of Wallace's Line and is connected to the Philippine Islands by two chains of relatively narrowly separated islands) and on a presumed dietary specialisation limiting *Harpyionycteris* to high altitude species of fruit.

Certain of the morphological characters, however, are clearly valueless or perhaps are unreliable for diagnostic purposes. The presence or absence of an accessory posterior cusp on the second upper premolar (pm^3) evidently lacks taxonomic reliability and the dimensions and form of the accessory canine cusp do not seem firm characters on which diagnosis can be based. The degree of proclivity of the upper canine may also prove unreliable: although in *celebensis* the upper canines are generally less proclivous than in *whiteheadi* the figure by Peterson & Fenton (1970, fig. 6) indicates that the upper canines of the subspecies *H. whiteheadi negrosensis* are nearer in proclivity to those of *celebensis* than to those of *H. w. whiteheadi.* According to Peterson & Fenton (1970) no more than three examples of this latter subspecies are known and of these only the holotype has been available for comparison: this suggests that *celebensis* differs from *H. w. whiteheadi* in its generally less forwardly projecting upper canines which are usually shorter and anteroposteriorly a little broader, and in a rather more deeply excavated median palate.

The zoogeographical case put forward by Peterson & Fenton (1970) also deserves further consideration. Apart from *Harpyionycteris* only *Acerodon, Dobsonia* and *Nyctimene* among other fruit bats are known so far to bridge the water gap between Sulawesi and the Philippine Islands yet apparently do not occur in Borneo. The large *Acerodon* occurs also on the Talaud Islands, and *Dobsonia* has one form, *chapmani*, on Negros Island (where *Harpyionycteris* is also found) apparently related to a predominantly Moluccan and New Guinea species, *D. moluccensis*. The genus *Nyctimene* has also been reported from Negros Island (Rabor *et al.*, 1970). The distribution pattern is clearly an unusual one for fruit bats and possibly as Peterson & Fenton suggest the Sulawesian population of *Harpyionycteris* may have been long isolated. On the other hand, Sulawesian specimens from R Ranu show that *Harpyionycteris* is not exclusively a high altitude bat, although in Sulawesi it was also

obtained at a considerable altitude on Mount Tambusisi, and not necessarily dependent on high altitude species of fruit that might not be available on small islands. It is probably correct to say as Peterson & Fenton (1970) do that it is a specialised feeder: its multicuspid teeth suggest a diet of hard fruit.

In view of these various considerations, for the present I also regard *celebensis* as specifically distinct from *H. whiteheadi,* but with strong reservations that this view may well be modified when fully adequate comparative material is available. In particular, further specimens of *H. whiteheadi whiteheadi* are required to establish the extent of dental variation in this subspecies, if any. It also seems possible that the distribution of *Harpyionycteris* is imperfectly known as yet, and that it may be found to occur at least on some of the other islands that abound in the Philippine and Sulawesian regions. Such additional material might prove highly relevant to any further consideration of the relative status of the two taxa.

NYCTIMENINAE

Nyctimene albiventer papuanus Andersen, 1910

Nyctimene papuanus Andersen, 1910 : 621. Milne Bay, Papua New Guinea.

Specimens examined. Papua New Guinea: ♂ BM(NH) 69.1417 Olsobip, Upper Fly R, 1500–2000 ft (skin, skull; coll. J. I. Menzies); ♀♀BM(NH) 73.2106–2025 Kairiru ridge, centre of Kairiru I, near Wewak, East Sepik, c. 2000 ft (in alcohol; coll. Aberdeen University Exploration Society Expedition to New Guinea, 1973); ♀ BM(NH) 78.867 Sapi Creek Forest Reserve, near Baku, Gogol Valley, Madang, c. 40 m (in alcohol), ♀ BM(NH) 78.868 Sapi Creek, c. 8 km E of Baku (skin, skull) (both coll. P. A. Morris); ♂ BM(NH) 80.565 Lobota Cave, Morobe, 7° 15′ S, 147° 09′ E, 18 ♂♂, 11 ♀♀ BM(NH) 80.566–594 Buso, Morobe, 7° 17′ S, 147° 08′ E (all in alcohol; coll. B. H. Gaskell, 'Operation Drake').

Nyctimene cephalotes cephalotes (Pallas, 1767)

Vespertilio cephalotes Pallas, 1767 : 10, pls. 1, 2. 'Moluccas'. Type locality fixed on Amboina I by Andersen (1912).

Specimens examined. Molucca Is: ♂, ♀, ♂ BM(NH) 81.1128–1130 Kaiteto, Amboina I (in alcohol; coll. B. H. Gaskell, 'Operation Drake').

C Sulawesi: 14♂♂, 4 ♀♀ BM(NH) 81.1131–1148 R Ranu, 1° 51′ S, 121° 30′ E (in alcohol; coll. B. H. Gaskell, 'Operation Drake').

Nyctimene major lullulae Thomas, 1904

Nyctimene major lullulae Thomas, 1904 : 197. Woodlark I, Trobriand Is.

Specimens examined. Papua New Guinea: ♂♂ BM(NH) 75.1861–1862 Kadovar I, Schouten Is, 3° 38 S, 144° 36′ E (in alcohol; coll. A. M. Jones, Aberdeen University Exploration Society).

Remarks. In overall size (length of forearm 69·9, 67·5; m^1–m^1 (crowns) 9·8, 9·9; (alveoli) 9·6, 9·7; c–m^1 12·0, 11·9) and in the size of their teeth these specimens generally approach more closely to *N. m. lullulae* than to either of the other subspecies known from the islands surrounding the northeastern and eastern coasts of New Guinea, namely *N. m. major* (Dobson, 1877*a*) from the Bismarck Archipelago and *N. m. geminus* Andersen, 1910 from eastern New Guinea and its associated islands.

Discussion. Koopman (1979) has discussed the distribution of *N. major* on the islands off northeastern New Guinea in some detail. This author found that while the larger subspecies *N. m. major* occurred on the more outlying islands of the Bismarck Archipelago, smaller specimens from the inshore islands of Karkar and Bagabag are similar in size to *N. m. lullulae* from the more easterly island of Woodlark. Kadovar Island lies considerably to the northwest of Karkar and Bagabag and is evidently occupied by a population of similar smaller overall size. More recently, Koopman (1982) has examined variation in this species on the islands off the eastern tip of New Guinea.

Nyctimene aello (Thomas, 1900)

Cephalotes aello Thomas, 1900 : 216. Milne Bay, Papua New Guinea.

Specimens examined. Papua New Guinea: ♂, (?) BM(NH) 68.1109–1110 Laloki, 9° 26′ S, 147° 20′ E (skins, skulls; coll. J. I. Menzies); ♂, ♀ BM(NH) 73.2031–2032 Victoria Bay, NW end of Kairiru I, near Wewak, East Sepik; ♂, ♀ BM(NH) 73.2033–2034 Sabor Kunai, E end of Kairiru I (all in alcohol; coll. Aberdeen University Exploration Society Expedition to New Guinea, 1973); 6 ♂♂, ♀ BM(NH) 80.595–601 Buso, Morobe, 7° 17′ S, 147° 08′ E (in alcohol; coll. B. H. Gaskell, 'Operation Drake').

Remarks. Specimens in dry preservation from Laloki are pale brown dorsally and have a broad black dorsal stripe extending almost to the head: one is fulvous ventrally, the other more buffy brown, the flanks in both rather more brownish. Those from Kairiru and Buso are brownish dorsally, with a similar generally broad dorsal stripe: the throat, chest and centre of the belly is dull buffy white or buffy brown shading into brownish on the flanks. All, however, have been preserved in alcohol.

Discussion. Laurie & Hill (1954) list *N. aello* with two subspecies, *N. a. aello* from eastern New Guinea and *N. a. celaeano* Thomas, 1922*a* & *b* from the western and northwestern parts of the island. According to Thomas (1922*a* & *b*) *celaeano* is slightly smaller than *aello* and is browner and less yellowish or fulvous, the dorsal surface less yellow and much of the ventral surface dull buffy white, the sides brown, not fulvous as in *aello.* These differences in colour between the holotypes of *celaeno* (BM(NH) 22.2.2.2) and *aello* (BM(NH) 99.12.3.1) are not entirely supported by the newly acquired material reported here or by other specimens in dry preservation in the collections of the British Museum (Natural History). The holotype of *celaeno* has the head, both above and below, the nape and the shoulders pale yellowish white, in contrast to the more fulvous coloration of the holotype of *aello*: the remainder of the dorsal surface is slightly paler than in *aello* and the ventral surface is dull buffy white, lacking the orange tinge characteristic of this specimen. A second specimen (BM(NH) 29.5.27.3) referred to *celaeno,* from Wasjor, West Irian almost exactly resembles the holotype of *aello* in coloration, corresponding closely in ventral colour to the more brightly coloured (BM(NH) 68.1110) of the two from Laloki. BM(NH) 1939.1351 from Tamata, Mambare River and BM(NH) 1939.1352 from Takar are a slightly paler brown dorsally than the holotype of *aello* and ventrally are less strongly tinged with fulvous or orange, corresponding to but a little brighter ventrally than the duller (BM(NH) 68.1109) of the two Laloki examples.

The coloration of the holotype of *celaeno* is characteristic of immersion in alcohol: Thomas (1922*b*) remarked 'Adult male, skinned out of spirit' and its original labels show that in fact it was collected in 1910 (not 1912 as stated by Thomas, 1922*b*). It may not have been prepared as a dry skin until 1921 or 1922. Careful examination shows that it does retain ventrally some trace of a brighter colour along the flanks, although much bleached. Moreover, there is little of this brighter ventral coloration in specimens of *aello* that although relatively recently collected have been preserved in alcohol. There is every indication, therefore that the colour of the holotype of *celaeno* is of limited value as a comparative feature.

However, there is a number of cranial and dental features by which the holotype of *celaeno* differs from *aello*. It has a much shorter, rather broader rostrum, wider interorbital and intertemporal areas, the frontal region is more elevated in contrast to the rather depressed frontal region of *aello* (commented upon by Thomas, 1922*b*), the supraorbital ridges are more swollen and inflated, and on the whole the teeth are generally smaller, the upper canines less obviously proclivous than in *aello*. For the present it seems more appropriate to consider it a distinct species allied to *N. aello*, at least until more specimens can be examined to establish its status: BM(NH) 29.5.27.3 from Wasjor, West Irian, hitherto referred to *celaeno*, agrees externally and cranially with *N. aello* to which it should be allocated. Tate (1942*c*) thought *celaeno* apparently closely allied to *N. major* from New Guinea and its associated islands but this species differs quite widely

Paranyctimene raptor Tate, 1942

Paranyctimene raptor Tate, 1942*a* : 1. Oroville Camp, Fly R, about 4 miles below mouth of Elavala R, Papua New Guinea.

SPECIMENS EXAMINED. (?) BM(NH) 68.1111, ♂ BM(NH) 69.317 Laloki, about 12 miles N of Port Moresby, 9° 26′ S, 147° 20′ E (skins, skulls; coll. J. I. Menzies); 2 ♂♂, 3 ♀♀ (1 yg.) BM(NH) 73.2024–2028 Rauit, West Sepik, 1750 ft, 3° 36′ S, 142° 15′ E; ♂ BM(NH) 73.2029 Biip, ½ mile SE of Rauit, 1650 ft; ♂, ♀ BM(NH) 73.2030, 73.2035 Rauit R, W of Rauit, 900 ft (all in alcohol; coll. Aberdeen University Exploration Society Expedition to New Guinea, 1973); ♀ BM(NH) 75.1860 Rauit, West Sepik (in alcohol; coll. A. M. Jones, Aberdeen University Exploration Society); ♀ BM(NH) 78.869 Baiyer R, c. 50 km NW of Mt. Hagen, Western Highlands; ♀ BM(NH) 78.870 Sapi Creek Forest Reserve, near Baku, Gogol Valley, Madang; ♂ BM(NH) 78.871 Baiyer R area, Western Highlands; ♂ BM(NH) 78.872 Mt Hagen (town), Western Highlands (all in alcohol; coll. P. A. Morris); 2 ♂♂, 2 ♀♀ BM(NH) 80.602–605 Buso, Morobe; ♀ BM(NH) 81.1149 Avi, Mt. Hagen, Western Highlands (all in alcohol; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. Specimens BM(NH) 73.2024–2030, 73.2035 are those reported by Grieg-Smith (1975) as *Nyctimene draconilla* Thomas, 1922*b*, which is similar in size and coloration to *Paranyctimene raptor*. This author commented upon the wide range extension that they indicated for *draconilla* (considered a subspecies of *N. albiventer* (Gray, 1863) by Laurie & Hill, 1954) and on their sympatric occurrence with *N. albiventer*, suggesting therefore that *draconilla* should be considered a distinct species. However, Koopman (1979) has reported the sympatric occurrence of *N. albiventer papuanus* with *N. draconilla* on the Upper Fly River in Papua New Guinea, later (1982) confirming his identification of *draconilla* from this locality.

MACROGLOSSINAE

Eonycteris spelaea (?) glandifera Lawrence, 1939

Eonycteris spelaea glandifera Lawrence, 1939 : 38. Montalban Caves, Rizal Province, Luzon, Philippine Is.

SPECIMENS EXAMINED. S Sulawesi: 2 ♀♀(1 yg.), ♂ BM(NH) 81.1110–1112 Lalonggasu Meeto (Tomba Watu Cave), 18 km from Kendari Central (in alcohol, skull of BM(NH) 81.1112 extracted; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. These specimens have longer forearms and cranially are a little larger in some respects than examples from Burma, Thailand, Malaya, Sumatra and Borneo. Moreover, the rostrum is larger, more massive and less tapered than in specimens from more westerly localities. The teeth of the male example, especially the canines, are a little larger than those of the adult female. Measurements: length of forearm (♂ BM(NH) 81.1112, ♀ BM(NH) 81.1111) 76·2, 74·2; cranial dimensions (♂ BM(NH) 81.1112): greatest length of skull 35·8;

greatest length of skull to canine 34·1; condylobasal length 34·0; condylocanine length 32·1; basal length to canine 30·1; palatal length 18·5; least interorbital width 6·9; least postorbital width 7·3; zygomatic width 22·4; width of braincase 14·3; mastoid width 13·8; width across occipital crests 13·1; c^1–c^1 (alveoli) 7·5; m^1–m^1 (crowns) 9·2; (alveoli) 9·2; c–m^2 13·0; length complete mandible from condyles 26·1; length right ramus from condyle 27·0; c–m_3 14·2.

Discussion. As Goodwin (1979) has pointed out, lack of material has led to some uncertainty in the classification of this genus. Detailed studies of *Eonycteris* may be said to begin with Andersen (1912), who recognised three species, *E. spelaea* (Dobson, 1871*a* & *c*), widely distributed from Burma to Sumatra, Java, the larger *E. major* Andersen, 1910 from northern Borneo, and, more doubtfully, *E. rosenbergi* Jentink, 1889 from Sulawesi, considering the last to be perhaps an aberrant *spelaea*. Subsequently Miller (1913) described *E. robusta* from Luzon Island, Philippine Islands. Chasen (1931) reported *spelaea* from Borneo, while Taylor (1934) reported further specimens from Luzon as *robusta* and described a second species, *longicauda*, from that island. However, Lawrence (1939) pointed out that Taylor had applied *robusta* to a hitherto undescribed subspecies of *E. spelaea* for which she proposed the name *glandifera*, and that in describing *longicauda* Taylor had in fact renamed *robusta* of Miller. Lawrence also indicated that specimens from Sumatra had no consistent characters separating them from *E. s. glandifera*, although Andersen (1912) had earlier thought Sumatran *Eonycteris* to be the same as those from Burma.

Tate (1942*c*) discussed the genus in some detail, recognising (excluding *rosenbergi* from Sulawesi) *spelaea, major* and *robusta* as distinct species. He concluded that two subspecies of *E. spelaea* could be recognised: one, *E. s. spelaea* he thought to extend from Burma and Vietnam through Malaya and Sumatra to east (sic) and central Java and possibly to Borneo (cf. Chasen, 1931), the other, *E. s. glandifera* occurring in the Philippines, in Bali, perhaps in eastern (sic) Java and probably in Borneo. Tate tentatively referred specimens from Bali to *E. s. glandifera*, others from southern Sumatra emphatically to *E. s. spelaea* rather than to *glandifera* as was done by Lawrence. More recently, Goodwin (1979) has provided an account of a female specimen from Timor Island which on size and coloration also appears to represent *E. s. glandifera*. Like Andersen (1912), Tate (loc. cit.) thought *rosenbergi* from Sulawesi most probably based on an anomalous specimens of *spelaea*. He also suggested that *robusta* (=*longicauda*) represented the Bornean *major* in the Philippine Islands and greatly extended the range of the latter species by referring to it a specimen from North Pagi Island, in the Mentawei Islands off west Sumatra.

The larger size and strong rostrum of specimens from Sulawesi suggests that they too should be referred to *E. s. glandifera*. Moreover, the Sulawesian male has the distinct throat band of long, tawny hairs described by Lawrence in *glandifera* and noted also in specimens from Bali by Tate (1942*c*). However, this feature seems less exclusive than implied by Tate who found no indication of this throat colouring in males of *E. s. spelaea*. Male specimens from Sarawak in the collections of the British Museum (Natural History) have an ochraceous tawny or even russet throat band although in other respects they agree closely with *E. s. spelaea* from the Asian mainland that like those seen by Tate lack any such coloration.

The status of *Callinycteris rosenbergi* Jentink, 1889 (=*Eonycteris rosenbergi*) remains uncertain. It is known only from the immature holotype in the Rijksmuseum van Natuurlijke Historie, Leiden, re-described in some detail by Andersen (1912). According to this author *rosenbergi* differs from *E. spelaea* in the absence of the last lower molar (m_3) on each side of the jaw; as he points out, m_3 is occasionally missing at least from one side of the jaw in *E. spelaea*. Miller (1907) who had seen a photograph of the holotype remarked on its heavy dentition. It is possible therefore that it is a young adult example of *E. s. glandifera*: certainly the palate ridges as illustrated by Jentink are characteristically the same as those of *E. s. glandifera* from Sulawesi. If this proves to be so, then *rosenbergi* must replace *glandifera* as the earlier name. In discussing this question Tate (1942*c*) erroneously refers to *rosenbergi* as *bernsteini* (a name actually used in the hipposiderid genus *Coelops*), thus creating a nomen nudum.

Macroglossus minimus lagochilus Matschie, 1899

Macroglossus lagochilus Matschie, 1899 : 96. Buru I, Molucca Is.

SPECIMENS EXAMINED. C Sulawesi: ♂ BM(NH) 81.1113 Ganda Ganda, 1°57′ S, 121°21′ E; 5 ♂♂, 5 ♀♀ BM(NH) 81.1114–1123 R Ranu, 1° 51′ S, 121° 21′ E; ♂, ♀ BM(NH) 81.1124–1125 Tambusisi Damar, Mt. Tambusisi, c. 4000 ft, 1° 39′ S, 121° 22′ E (in alcohol; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. Specimens from Sulawesi agree closely with those from the Molucca Islands and from Borneo. Length of forearm in thirteen examples 38·4–41·9.

DISCUSSION. There is considerable taxonomic confusion in the genus *Macroglossus,* not least resulting from its treatment by Andersen (1911, 1912), and identification difficulties have until recently been common with specimens from the western part of its range in Malaysia, Sumatra and Java. Mr A. N. Start (in litt.) has examined and studied *Macroglossus* from this region, but his findings have yet to be published. In the meantime, however, his views have influenced Lekagul & McNeely (1977) and Medway (1978) (or indirectly Ziegler, 1982) but these authors give no justification for their adoption of combinations of names differing from the generally used classification of Andersen (1912).

Thomas (1889) first recognised the existence of two species of *Macroglossus* when examining specimens from Aola, Guadalcanal Island in the Solomon Islands. These he distinguished readily from others from Java by the presence of a deep internarial groove extending to the upper lip, much shorter face, i.e. rostrum, and smaller size, their forearm lengths ranging from 38–43 mm, while in the Javan specimens the length of the forearm ranged from 45–48 mm. These specimens from the Solomon Islands he wrongly called *M. australis* (actually *Syconycteris australis*): in fact, they represent the form called *M. lagochilus* by Andersen (1912). Those from Java Thomas called *M. minimus*: their size refers them undoubtedly to the form called *M. minimus sobrinus* by Andersen (1911, 1912).

Andersen (1911, 1912) reviewed the genus in considerable detail. Basing his conclusions on the directionality of the nares and the extent and depth of the internarial groove, this author recognised two species, *M. minimus,* Indo-Chinese and Indo-Malayan, and *M. lagochilus,* Austro-Malayan, but with no distributional overlap. According to Andersen, *minimus* extended eastward through Java to Madura and Kangean Islands, perhaps to Timor, while *lagochilus* extended westward to Borneo and the Philippine Islands. He also recognised the existence of two forms in Java, one smaller, with shorter rostrum, which he called *M. minimus minimus,* the other larger, with relatively longer rostrum, which he called *M. minimus sobrinus,* this latter subspecies ranging to Sumatra, the Malay Peninsula, Thailand, Burma and northeastern India. Specimens examined by Thomas (1889) clearly represent this form, against which he compared *lagochilus* from the Solomon Islands. It is also worth noting that many years earlier Temminck (1837) had remarked upon differences in muzzle length in *Macroglossus,* recording that specimens from Sumatra had excessively long muzzles; the muzzles of those from Java proved a little shorter and little different from the muzzles of specimens from Timor, while others from Amboina Island had remarkably short muzzles compared with those of Sumatran examples. Andersen (loc. cit.) regarded *M. minimus minimus* as Javan, with *M. m. sobrinus* extending westward from Java through Sumatra to the Asian mainland: he also thought that *M. m. minimus* might be found to occur on Sumatra and in the Malay peninsula. Since Andersen wrote the Malaysian range of *lagochilus* has been much extended, Chasen (1940) for example recording it from as far west as Peninsular Thailand, Malaya and Nias Island, off west Sumatra, while Lekagul & McNeely (1977) record specimens (as *M. minimus*) from southeastern Thailand and Vietnam. It has not, however, been recorded from Java.

The directionality of the nares and the extent and depth of the internarial groove are characters that are sometimes variable or subjective, distorted in preserved specimens and sometimes difficult to observe. Goodwin (1979) for example was unable to discern any

difference in the direction in which the nostrils face between Malayan *sobrinus* and *lagochilus* from Malaya, Sulawesi and the Solomon Islands, although this author pointed out that in *lagochilus* the margins of the nares are raised to show a tendency towards the development of incipient tubes.

Specimens in the British Museum (Natural History) establish quite clearly the presence of two forms in Java. The larger of these (length of forearm (4) 45·5–48·1, condylobasal length (4) 26·4–26·9) has a long rostrum (length orbit–nares (5) 10·4–11·0) and the lower jaw projects forward beneath the incisors to form a distinct sub-square chin. The nostrils are not raised marginally to form an incipient tubular structure and the internarial groove is represented at most by a narrow linear depression extending about halfway to the upper lip, or is obsolete. These correspond to the form called *sobrinus* by Andersen (1911, 1912). The smaller (length of forearm (19) 39·5–44·2, condylobasal length (9) 22·8–25·3) has a short rostrum (length orbit–nares (10) 8·1–9·2) and the mandible slopes posteriorly beneath the incisors, with rarely any suggestion of a squarish chin. The nostrils show no suggestion of a tubular form, but the internarial groove extends as a narrow linear depression to the upper lip, which is not divided. These correspond to the form called *minimus* Geoffroy, 1810*a* by Andersen (loc. cit.). It is not certain to which of the two Javan forms Geoffroy's name refers and the syntypes apparently are lost (Andersen, 1912) but for the present it seems both convenient and sensible to retain Andersen's fixation of this appropriate name on to the smaller form. Similar smaller specimens come from Madura and Kangean Islands. Tate (1942*c*) clearly appreciated the differences between *minimus* and *sobrinus,* recording the former from Cheribon, Java and from Bali, and the latter from North Pagi Island, Mentawei Islands, off west Sumatra. Although direct sympatry has not been demonstrated the conclusion that these represent distinct species seems unavoidable.

The collections also contain specimens of the larger form from Sumatra, Nias Island, Simalur Island, Malaya, Thailand and the island of Koh Samui. These agree in every essential point with the limited Javan representation: following Andersen (1912) they should be referred to *sobrinus* which is considered to be a distinct species, ranging certainly from Burma and Thailand south through the Malay Peninsula and Sumatra to Java. Length of forearm (16) 44·2–49·8, condylobasal length (6) 25·4–28·6, and length orbit–nares (6) 10·1–11·7.

Medway (1978) differentiated the two forms in Malaya by the features of the head and rhinarium: in the smaller (hitherto called *lagochilus,* cf. Chasen, 1940) the head is shorter, the nostrils forward pointing, with a distinct median internarial groove extending to the upper lip and flanked by two smaller grooves while in the larger (*sobrinus*) he noted that the head is longer, the nostrils more upwardly directed, and the median groove vestigial. He called the smaller form *M. minimus minimus,* thereby implying the synonymy of *lagochilus* with the Javan *minimus.* However, specimens from Malaya, Borneo, the Philippine Islands and Sulawesi have the margins of the nares raised to form a slightly tubular structure as was noted by Goodwin (1979) of specimens from Timor, and they have generally a more prominent internarial groove than do specimens from Java. In these respects and in size they agree with *lagochilus* from the Molucca Islands and for this reason I maintain *lagochilus* as a distinct subspecies, extending from southern Thailand and southern Vietnam through the Malay Peninsula to Borneo, the Philippines, Sulawesi, the Molucca Islands and Timor. Apparently neither *M. minimus minimus* nor *M. minimus lagochilus* have been recorded from Sumatra but Chasen (1940) reported the latter (with *sobrinus*) from the island of Nias, off the west coast.

The species and subspecies of *Macroglossus* may be briefly summarised:

Macroglossus minimus (Geoffroy, 1810*a*)	
M. m. lagochilus Matschie, 1899	S. Thailand, S Vietnam, Malaya, Nias I, Sirhassen I, (?) Sri Buat I; (?) Bunguran I,

	North Natuna Is; Borneo to Philippine Is, Sulawesi, Peleng I, Sanghir Is and Molucca Is.
M. m. minimus (Geoffroy, 1810*a*)	Java, Bali, Madura I, Kangean Is.
M. m. nanus Matschie, 1899	Aru Is, Kei Is, Mysol I, New Guinea, Bismarck Archipelago, Admiralty Is; Queensland, Australia.
M. m. pygmaeus Andersen, 1911	Murray I, Torres Straits
M. m. microtus Andersen, 1911	Bougainville, San Christobal, Guadalcanal and Florida Is, Solomon Is.

McKean (1972) considered *M. m. pygmaeus* and *M. m. microtis* to be synonyms of *M. m. nanus*. His measurements, which do not include any of topotypes either of *pygmaeus* or of *microtis*, certainly suggest that this may be so.

Macroglossus sobrinus Andersen, 1911	
M. s. sobrinus Andersen, 1911	Burma and Thailand to Sumatra, Nias I, Krakatoa I and Java.
M. s. fraternus Chasen & Kloss, 1927	Sipora and Siberut Is, Mentawei Is.

Macroglossus minimus nanus Matschie, 1899

Macroglossus nanus Matschie, 1899 : 98. Lamellana, New Britain, Bismarck Archipelago.

SPECIMENS EXAMINED. Papua New Guinea: ♀ BM(NH) 73.1974 Victoria Bay, Kairiru ridge, NW end of Kairiru I, near Wewak, East Sepik (in alcohol; coll. Aberdeen University Exploration Society Expedition to New Guinea, 1973); ♀♀ BM(NH) 75.1840 Sepik, BM(NH) 75.1841 Rauit, West Sepik, 3° 36′ S, 142° 15′ E (both in alcohol; coll. A. M. Jones, Aberdeen University Exploration Society); (?) ♀♀ BM(NH) 78.858–859 Sapi Creek Forest Reserve, near Baku, Gogol Valley, c. 40 m (in alcohol; coll. P. A. Morris); ♀ BM(NH) 80.530 Kuni, Morobe, 7° 22′ S, 147° 11′ E; 3 ♂♂ (1 yg.), 4 ♀♀ (1 yg.) BM(NH) 80.531–537 Buso, Morobe, 7° 17′ S, 147° 08′ E (all in alcohol; coll. B. H. Gaskell, 'Operation Drake').

New Britain, Bismarck Archipelago: ♀ ♂ BM(NH) 69.309–310 Kareeba Plantation, Keravat. 4° 18′ S, 152° 01′ E (skins, skulls; coll. J. I. Menzies).

REMARKS. Apart from the cranial and dental characters to which Andersen (1912) drew attention, *M. m. nanus* is generally a little smaller than *M. m. lagochilus*, the length of the forearm in *nanus* (13) 36·2–42·8, in *lagochilus* (32) 38·0–44·0. Specimens from the Aru Islands and the Bismarck Archipelago are similar to those from New Guinea with length of forearm (6) 36·3–38·7. Hitherto unrecorded examples in London include BM(NH) 37.2.16.1 from north of Eilanden R, West Irian, and BM(NH) 29.5.27.7 from Wasjor, also in West Irian. A single specimen, BM(NH) 15.3.5.5 from Piara, Cape York, Queensland, Australia agrees closely with *nanus* in size and length of rostrum rather than with *M. m. pygmaeus* from Murray Island, Torres Straits. Tate (1952) also recorded *M. m. nanus* from Cape York: McKean (1972) reports specimens from Australia.

Macroglossus sobrinus sobrinus Andersen, 1911

Macroglossus sobrinus Andersen, 1911 : 642. Gunong Igari, Perak, Malaya.

SPECIMENS EXAMINED. Krakatoa I, 06° 10′ S, 105° 26′ E: ♀ BM(NH) 74.241 (in alcohol; coll. G. Lincoln).

REMARKS. There appears to be no previous record of *Macroglossus* from Krakatoa: among bats, Dammerman (1938) reported only *Rousettus amplexicaudatus, Cynopterus brachyotis angulatus* (=*C. sphinx angulatus*), *Cynopterus horsfieldi minor* (=*C. h. lyoni*) and *Hipposideros diadema* from the island. This specimen has slightly forwardly directed nostrils and a moderate internarial groove that extends towards the upper lip as a narrow linear depression, but does not reach it. The keel beneath the mandibular symphysis is prominently developed into an anteriorly projecting, square chin. Length of forearm 45·7.

Macroglossus sobrinus fraternus Chasen & Kloss, 1927

Macroglossus minimus fraternus Chasen & Kloss 1927: 836, Sipora I. Mentawei Is, off west coast Sumatra.

SPECIMENS EXAMINED. Siberut I, Mentawei Is, off west coast Sumatra: ♀, 4♂♂ BM(NH) 78.2921–2925 Base of Tetei Bulak, Sabeuleleu, Paitan R, off Saibi R (in alcohol; coll. J. J. Whitten).

REMARKS. Chasen & Kloss (1927) referred an adult male from Siberut to *fraternus*. These specimens with length of forearm 49·3–50·9 agree in size with the original material examined by these authors, differing from the nominate subspecies in their greater dimensions. In all the nostrils open laterally and face to the side, and the internarial groove is obsolete or at best is represented by a shallow linear depression that does not extend anteriorly beyond the immediate internarial area. Possibly specimens reported by Tate (1942*c*) from North Pagi Island, Mentawei Islands as *M. minimus sobrinus* (=*M. sobrinus sobrinus*), of which he notes some are very large, also represent *M. s. fraternus*

Syconycteris australis papuana (Matschie, 1899)

Macroglossus (Syconycteris) papuanus Matschie, 1899: 95, 99. Andai, NW West Irian.

SPECIMENS EXAMINED. Papua New Guinea: ♂, ♀ BM(NH) 69.311–312 Schrader Mts., above Kaironk, 8500 ft c. 5° 10′ S, 144° 26′ E; ♀♀ BM(NH) 69.313–314 Efogi, Owen Stanley Mts., c. 40 miles E of Port Moresby, 3000 ft, 9° 07′ S, 147° 42′ E (all skins, skulls; coll. J. I. Menzies); 6 ♂♂, 4 ♀♀ BM(NH) 73.1975–1984 Biip, ½ mile SE of Rauit, West Sepik, c. 1650 ft, 3° 36′ S, 142° 15′ E: 4♂♂ BM(NH) 73.1985–1988 Rauit, 1750 ft, 3° 36′ S, 142° 15′ E: 13 ♂♂, 8 ♀♀ (1 yg.) BM(NH) 73.1989–2009 Kairiru ridge, centre of Kairiru I, near Wewak, East Sepik, c. 2000 ft; 3♂♂, ♀ BM(NH) 73.2010–2013 Victoria Bay, NW end of Kairiru I: ♂ BM(NH) 73.2014 Sabor, E end of Kairiru I (all in alcohol); BM(NH) 74.339–374 Near Rauit, 3° 36′ S, 142° 15′ E (skulls only) (all coll. Aberdeen University Exploration Society Expedition to New Guinea, 1973); ♂ BM(NH) 75.1848 Wageo I. Schouten Is. East Sepik; 3 ♂♂ BM(NH) 75.1849–1851 St. Xaviers, Kairiru I, East Sepik, c. 3° 21′ S, 143° 36′ E; 4 ♂♂, 4 ♀♀ BM(NH) 75.1852–1859 Sepik (all in alcohol; coll. A. M. Jones, Aberdeen University Exploration Society); 3 ♂♂, 2 ♀♀ BM(NH) 76.381–385 Okapa, Eastern Highlands, 6500 ft (in alcohol, coll. H. King); ♀ BM(NH) 78.860 Baku, Gogol Valley, Madang (skin only); ♀♀ BM(NH) 78.861–862 Baiyer R, c. 50 km NW of Mt. Hagen, Western Highlands, 1300 m; ♀ BM(NH) 78.863 Sapi Creek Forest Reserve, near Baku, Gogol Valley, Madang, c. 40 m; ♀♀ BM(NH) 78.864–865 Baiyer R area, Western Highlands, c. 1300 m; ♂ BM(NH) Mt. Hagen (town), Western Highlands (all in alcohol) (all coll. P. A. Morris); ♂ BM(NH) 80.538 7 km WSW of Buso, Morobe; ♂ BM(NH) 80.539 Rasange, Morobe; ♀ BM(NH) 80.540 Mt. Misson, Wau, Morobe; 15 ♂♂, 7 ♀♀, 2 (?) BM(NH) 80.541–564 Buso, Morobe (all in alcohol; coll. B. H. Gaskell, 'Operation Drake').

DISCUSSION. Andersen (1912) recognised three species of *Syconycteris*, separated only by the features of the post-canine dentition, the last premolars ($pm\frac{4}{4}$) and first molar ($m\frac{1}{1}$) in *S. crassa* (Thomas, 1895) being elongate and decidedly more than half as wide as long, those of *S. australis* (Peters, 1867*a*) linear, their width only half their length, while *S. naias*

Andersen, 1911 was distinguished from the latter by the absence of the last upper (m^2) and lower (m_3) molars. At the time that Andersen wrote none had been found to be sympatric, *S. crassa* extending from Amboina in the Molucca Islands to New Guinea and some associated islands, *S. australis* occurring only in Queensland, and *S. naias* only on Woodlark Island in the Trobriand Islands. Tate (1942*c*) reported both *S. crassa* and *S. australis* from New Guinea, the two being collected together in the Central Division of Papua behind Port Moresby: Laurie & Hill (1954) followed the arrangement proposed by Andersen and implicitly adopted by Tate. Since then a highland species, *S. hobbit* Ziegler, 1982 has been described.

Lidicker and Ziegler (1968) reported a high degree of variability in the number of post-canine teeth in specimens of the *australis* type from the islands off southeastern New Guinea, including Woodlark, with the post-canine formula varying from $\frac{4}{5}$ to $\frac{5}{6}$ and exceptionally to $\frac{5}{7}$, as a result considering *naias* to be no more than subspecifically distinct from *australis*. A similar incidence of dental anomalies, the absence of one to four molars, or the presence of one or two supernumerary molars, was found by McKean (1972) in a large number of specimens referred to *australis* or to *crassa*. This author considered *naias* and *australis* synonymous, and pointed out that Brass (1959) had already recorded the latter, apparently with normal dentition, from Woodlark Island. Moreover, McKean found that in a large series of specimens from Papua New Guinea that he referred to *crassa* some had teeth nearly as narrow as *australis*, while a few juveniles without fully developed teeth could easily have been mistaken for that form. He concluded that but for the account by Tate (1942*c*) he would have considered *crassa* and *australis* only subspecifically related.

When first examined at the British Museum (Natural History) in 1974 the series of skulls (BM(NH) 74.339–374) led Hill (in Grieg-Smith, 1975) to the conclusion that *crassa* as understood by Andersen (1912) and Tate (1942*c*) could not be separated from *australis* since the dimensions of the relevant cheekteeth extended over most of the range of both alleged species. This variation does not conform to the definitions of Andersen or of Lidicker & Ziegler who redefined Andersen's dental criteria, pm^4_4 and m^1_1 according to these authors being less than one and one half times as long as broad in *crassa*, but in *australis* being one and one half times as long as broad, or more. Within the series now available pm^4 varies in length from approximately 110–200% of its width, pm_4 from 140–230%, m^1 from 100–180% and m_1 from 150–200%. Moreover, on occasion in a single specimen pm^4 and sometimes m^1 conform to the broader, elongate outline considered characteristic of *crassa* while pm_4 and m_1 are narrower and more linear, their proportions more nearly those ascribed to *australis*. The variation in tooth proportions is such that there is no point at which a division into two species on the basis of this character can be made.

Lidicker & Zeigler (1968) add that in *crassa* m^2 and m_3 are normally present although sometimes absent in *australis*, that the inner upper incisors tend to be slightly separated in *crassa* but in contact in its congener, and that the latter has shorter fur. McKean (vide supra) has demonstrated a wide degree of variation in the number of post-canine teeth in specimens from eastern New Guinea and this topic is also discussed in some detail by Koopman (1982) who concludes that molar number is not a good species character: among BM(NH) 74.339–374 only one specimen (74.344) has an obviously anomalous dental formula, lacking m^2 and m_3 on both sides. In this specimen, pm^4 and m^1 are sub-circular, pm_4 and m_1 rather more linear in outline, thus in the upper jaw conforming to the definition of *crassa*, in the mandible tending towards *australis*.

The series includes specimens which have the inner upper incisors convergent, in contact, very slightly separated, or not at all convergent and more distantly separated by a narrow but obvious interspace. However, this variation does not correlate with the features of pm^4_4 and m^1_1. At the extremes, BM(NH) 74.339 for example has inner upper incisors that stand separately but has strongly linear pm^4_4 and m^1_1, while BM(NH) 74.343 has convergent incisors that touch but sub-circular pm^4 and m^1, their mandibular counterparts only slightly elongate and not at all linear. Koopman (1979) could find no dichotomy into broad and narrow toothed forms, while Ziegler (1982) in describing the montane species *S. hobbit* examined six

of the specimens referred to *australis* or to *crassa* by Tate (1942*c*) and was unable to find any consistent differences in tooth dimensions that would differentiate the two putative species. Moreover, Ziegler also could not establish any external, cranial or dental characters to suggest such a distinction among the extensive representation of relevant *Syconycteris* in the Bernice P. Bishop Museum, Hawaii.

The recognition that *australis* is conspecific with *crassa* means that as the prior name *australis* must become the specific epithet and possibly the subspecific name for the population in New Guinea usually called *papuana.* However, Koopman (1979) remarked that Australian specimens of which he had seen a limited sample tend to be smaller than those from New Guinea and tentatively retains *australis* and *papuana* as distinct subspecies. The remaining subspecies of *S. australis* also seem only slightly differentiated. They include *crassa* (Thomas, 1895) from the islands southeast of New Guinea, *keyensis* Andersen, 1911 from the Kei Islands, *major* Andersen, 1911 from Amboina and Ceram Islands, in the Molucca Islands, and *finschi* (Matschie, 1899) from the Bismarck Archipelago. McKean (1972) synonymised *keyensis* and *finschi* with *papuana,* and regarded *naias* as a synonym of *australis* (=*S. australis australis*), Lidicker & Ziegler (vide supra) having considered the latter two to be subspecifically related as does Koopman (1982), who carried out a detailed examination of specimens from eastern Papua and its associated islands. However, Koopman (1979) retained *finschi* on account of its slightly smaller size when compared with *papuana*: measurements of BM(NH) 74.339–374 (condylobasal length 23·2–24·8, width of braincase 10·2–11·4) agree with those of New Guinea specimens measured by this author and support his contention. Possibly *naias* from Woodlark Island is synonymous with *australis* but may prove to be another weakly separable subspecies.

According to Zeigler (1982) the dorsal pelage of *S. australis* in any area is apparently slightly less dense and less woolly, inter alia, than that of *S. hobbit,* the two so far being found to be sympatric only at Mount Kaindi, Morobe, Papua New Guinea. The two specimens (BM(NH) 69.311–312) of *S. australis* reported here from the Schrader Mountains at 8500 ft have longer, slightly denser fur than do those from lower locations, and are also a little darker in overall coloration, thus confirming the observation by Ziegler that high level examples were the darkest to be found in the species. It seems possible that a high altitude subspecies of *S. australis,* which according to Ziegler occurs as high as at least 3000 m, might be recognised in due course.

Syconycteris australis major Andersen 1911

Syconycteris crassa major Andersen, 1911 : 643, Amboina I. Molucca Is.

Specimens examined. Molucca Is: ♂♂ BM(NH) 81.1126–1127 Kaiteto, Amboina I (in alcohol; coll. B. H. Gaskell, 'Operation Drake').

Remarks. In length of forearm (46·0, 47·5) these specimens fall within the range given by Andersen (1911, 1912) for this larger subspecies.

Notopteris macdonaldi macdonaldi Gray, 1859

Notopteris macdonaldi Gray, 1859 : 38, pl. 67. Viti Levu I, Fiji Is.

Specimens examined. Fiji Is: 6 ♂♂, 6 ♀♀ (1 yg.) BM(NH) 78.2394–2405 Saweni Navosi/Koro Bulia, Sigatoka Valley, Viti Levu I, 17° 39′ S, 177° 30′ E (skins, skulls; coll. J. C. Pernetta).

New Hebrides: ♂♂ BM(NH) 73.1319–1320 (1 yg.) Analghaut Village, Aneityum I, near sea level; 3 ♂♂, ♀ BM(NH) 73.1321–1324 About 2 km E of 'Bethel', Tanna I, 120 m; 3 ♂♂ (2 nurselings), 4 ♀♀, 1 (?) BM(NH) 73.1325–1332 Watantup, about 4 miles N of Ipota, east coast Erromanga I, at sea level; ♂ BM(NH) 73.1333 Nokowoula, Espiritu Santo I, 3700 ft (all in alcohol except BM(NH) 73.1331–1332, skins; coll. or obtained by the Earl of Cranbrook, Royal Society Expedition to the New Hebrides, 1971).

REMARKS. Specimens obtained by the Royal Society Expedition in 1971 extend *N. macdonaldi* to most of the major islands of the New Hebrides, whence before it has been known in the literature apparently only from Aneityum (Andersen, 1912). The collections of the British Museum (Natural History) also include two females (BM(NH) 26.6.4.7–8) from Efate Island.

DISCUSSION. The two subspecies of *N. macdonaldi, N. m. macdonaldi* (Fiji Is and New Hebrides) and *N. m. neocaledonica* Trouessart, 1908 (New Caledonia) differ chiefly in the smaller size of the latter (Andersen, 1912, Revilliod, 1914, Sanborn & Nicholson, 1950): specimens in the collections of the British Museum (Natural History) suggest also that generally *neocaledonica* has a lower, rather less massive rostrum than *macdonaldi.* Measurements given by Revilliod (1914) and by Sanborn & Nicholson (1950) when comparing Fijian *macdonaldi* with *neocaldonica* indicate a considerable difference in forearm length that is not entirely supported by specimens in London. Sanborn & Nicholson in fact suggested that the forearm length of Fijian *macdonaldi* is always longer than in *neocaledonica,* although they had seen no adult male of this latter subspecies. These authors indicated that in Fijian *macdonaldi* the length of the forearm did not fall below 63·9 and that in *neocaledonica* it did not exceed 61·5. However, a series of specimens (BM(NH) 19.10.8.5–15) from Mount Tambignon, New Caledonia, at 2500 ft have forearms ranging in length from 60·2–63·4 in males and in females from 60·3–64·3.

Specimens from the Fiji Islands and from the New Hebrides tend to further bridge the alleged size difference. Six Fijian males range in forearm length from 63·5–68·8 (but Sanborn & Nicholson (1950) report a male of 71·3), five females from 63·0–66·0. In the New Hebrides a male from Aneityum has a forearm length of 69·9 and a female (BM(NH) 25.12.14.11) of 65·1. Three males from Tanna have forearms varying in length from 65·0–69·0, a female a forearm length of 62·8. The adult male from Erromanga has a forearm length of 61·5, four females from the same island having forearms ranging in length from 61·6–63·6, while the adult but not old male from Espiritu Santo has a forearm length of 64·8.

Sanborn & Nicholson (1950) reported the presence of a strong sagittal crest extending from the frontals to well-developed lambdoidal crests in males of *N. m. macdonaldi,* females lacking a sagittal crest but possessing similar well-developed lambdoidal crests. A slightly less developed sagittal crest is also present in the older males of *N. m. neocaledonica.*

MICROCHIROPTERA

EMBALLONURIDAE

Emballonura alecto alecto (Eydoux & Gervais, 1836)

Vespertilio (Nycticeius) alecto Eydoux & Gervais, 1836 : 7. Manila, Luzon I, Philippine Is.

SPECIMENS EXAMINED. C Sulawesi: ♂♂ BM(NH) 82.1–16 Tapu Waru, 1° 55′ S, 121° 22′ E; ♀ BM(NH) 82.17 Ganda Ganda, 1° 57′ S, 121° 21′ E; ♀, ♂ BM(NH) 82.18–19 Tarongga, 1° 44′ S, 121° 40′ E (all in alcohol, skulls of BM(NH) 82.1–5, 82.13 extracted; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. These specimens are referred to *E. alecto* rather than to the closely similar species *E. monticola* Temminck, 1838 by virtue of their rather large skulls which have a relatively long antemolar region, with a marked diastema between the first upper premolar (pm^2) and the second upper premolar (pm^4). Tate & Archbold (1939) recorded *E. alecto* from Likeopang, north Sulawesi and from Peleng Island on the basis of specimens in the United States National Museum of Natural History, Washington. These are evidently those reported among others (in this case from Limpoeang) by Shamel (1940) as *E. monticola rivalis* Thomas, 1915*c* (=*E. alecto rivalis*). Although comparative material is limited, specimens from Sulawesi and the Molucca Islands agree most closely in several points of size with examples from the Philippine islands and are referred to the nominate subspecies.

Emballonura monticola also occurs in Sulawesi whence it has been recorded from the southern part of the island by Tate & Archbold (1939).

Measurements of specimens from Sulawesi: length of forearm (19) 43·1–48·3; greatest length of skull (6) 14·7–15·1; condylobasal length (6) 13·5–14·0; condylocanine length (6) 12·9–13·2; width of rostral swellings (6) 5·9–6·2; least interorbital width (4) 4·7–5·0; least postorbital width (6) 2·7–3·0; zygomatic width (5) 8·7–9·1; width of braincase (6) 6·8–7·1; mastoid width (6) 7·5–8·2; c^1–c^1 (alveoli) (6) 3·6–4·0; m^3–m^3 (6) 6·1–6·4; c–m^3 (6) 5·5–5·7; length complete mandible from condyles (4) 9·8–10·0; length right ramus from condyle (6) 10·1–10·6; c–m_3 (6) 5·6–5·9.

Emballonura nigrescens papuanus Thomas, 1914

Emballonura papuanus Thomas, 1914*b* : 443. Wakatimi, Mimika R, SW west Irian.

Specimens examined. Papua New Guinea: ♂ BM(NH) 80.606 Buso, Morobe, 7° 17′ S, 147° 08′ E (in alcohol; coll. B. H. Gaskell, 'Operation Drake').

C Sulawesi: ♂ BM(NH) 82.20 R Ranu, 1° 51′ S, 121° 30′ E (in alcohol, skull extracted; coll. B. H. Gaskell, 'Operation Drake').

Remarks. The short, blunt muzzle, widely separated elliptical nostrils and long, narrow tragus with backwardly directed tip quite clearly refer these specimens to *E. nigrescens.* The example from Sulawesi has a slightly larger and more inflated braincase than *E. n. nigrescens* (Gray, 1843*a* from the Moluccan islands of Amboina, Buru and Ceram and on this account is referred to *E. n. papuanus,* otherwise known from Ternate Island, New Guinea and the Schouten and Kei Islands. According to Thomas (1914*b*) the rostrum of *E. n. papuanus,* is also short and stumpy but this feature is not at all obvious in the series in the British Museum (Natural History). Tate & Archbold (1939) and Shamel (1940) have also recorded the subspecies from Sulawesi. Measurements of the Sulawesian example BM(NH) 82.20: length of forearm 32·2; greatest length of skull 11·0; condylobasal length 10·4; condylocanine length 10·2; width rostral swellings 4·0; least interorbital width 3·0; least postorbital width 2·3; zygomatic width —; width of braincase 6·0; mastoid width 6·2; c^1–c^1 (alveoli) 3·0; m^3–m^3 5·1; c–m^3 4·2; length complete mandible from condyles —; length right ramus from condyle 7·9; c–m_3 4·4.

Taphozous melanopogon Temminck, 1841

Taphozous melanopogon Temminck, 1841 : 287, pl. 60, figs. 8, 9. Bantam, W Java.

Specimens examined. S. Sulawesi: ♀♀ BM(NH) 82.12–22 Lalonggasu Meeto, (Tomba Watu Cave), 18 km from Kendari Central (in alcohol, skulls (of BM(NH) 81.22 fragmentary) extracted; coll. B. H. Gaskell, 'Operation Drake').

Remarks. Although these specimens have relatively long forearms, the distribution of the fur at the sides of the body, unlengthened rostrum, rather narrow, elongate braincase and smaller teeth, especially the canines, suggests that they should be referred to *T. melanopogon* rather than to the closely similar species *T. theobaldi* Dobson, 1872*a.* The latter was reported from Java by Thomas & Wroughton (1909) on the basis of specimens now in the collections of the British Museum (Natural History): these, although smaller than a very limited sample of *T. theobaldi* from India, Burma and Thailand have longer forearms (71·1–72·5 in ten examples) than the specimens from Sulawesi here referred to *T. melanopogon,* and their skulls are generally larger. Unfortunately, few specimens of *T. melanopogon* are known from Java: the species occurs otherwise from India and southern China to the Philippine Islands and the islands of Sumbawa, Savu and Timor in the Lesser

Sunda chain. These from Sulawesi are the first of *T. melanopogon* to be recorded from that island: in size they are similar to those reported by Goodwin (1979) from Timor, or to *T. m. achates* Thomas, 1915*b* from Savu Island.

Measurements (BM(NH) 82.21, 82.22): length of forearm 68·5, 67·7; greatest length of skull —, —; condylobasal length —, —; condylocanine length 21·6, —; least interorbital width 6·4, 6·4; least postorbital width 5·3; —; zygomatic width 13·1, —; width of braincase 10·3, —; mastoid width 11·6, —; c^1–c^1 (alveoli) 4·3, —; m^3–m^3 9·3; —; c–m^3 9·8, 9·5; length complete mandible from condyles 16·8, 16·4; length right ramus from condyle 17·4, 16·9; c–m_3 10·7, 10·4.

Discussion. The genus *Taphozous* has remained unrecorded from Sulawesi until comparatively recently, although its overall Oriental distribution from the Indian subcontinent to the Philippine Islands and Australia clearly indicates that it might be expected to occur on that island. Apart from *T. (Taphozous) melanopogon,* the pouch-bearing bat *T. (Saccolaimus) saccolaimus* Temminck, 1841 has been reported lately from Sulawesi, Fieler (1980) having identified an old specimen dating from 1883 in the Staatliches Museum für Tierkunde, Dresden as an example of this species. It has been known to occur hitherto from India to Borneo, Java and Timor, and may extend to New Guinea, the Solomon Islands, the Northern Territory of Australia and northeastern Queensland if *nudicluniatus* De Vis, 1905 is conspecific with *saccolaimus* as Goodwin (1979), McKean *et al.* (1980) and Koopman (1982) suggest.

MEGADERMATIDAE

Megadema spasma niasense Lyon, 1916

Megaderma niasense Lyon, 1916 : 440. Nias I, off W Sumatra.

Specimens examined. Siberut I, Mentawei Is: ♂♂ BM(NH) 78.2926–2928 Near Sibosua R, Paitan R, off Saibi R; ♀♀ BM(NH) 78.2929–2931 Ridge to the E of Sibosua R (all in alcohol, skulls of BM(NH) 78.2929–2930 extracted; coll. J. J. Whitten).

Remarks. There is no previously published record of *M. spasma* from Siberut although the species has been recorded widely (Lyon, 1916, Chasen, 1940) from the island chain of which Siberut forms a part. These specimens agree in many respects with the description of *naisense* from the island of Nias to the northwest of Siberut: they are a little smaller on the whole than *M. s. trifolium* Geoffroy, 1810*b* from Java and southern Sumatra, with the parts of the maxillae over the canines less enlarged and the tympanic bullae and teeth generally smaller. External measurements: length of forearm (6) 55·9–58·8; length of ear (6) 32·0–33·4; length of tibia (6) 31·1–32·2. Cranial measurements (BM(NH) 78.2929, 78.2930): greatest length of skull 24·8, 25·5; condylocanine length 21·5, 22·8; least interorbital width 3·9, 4·0; zygomatic width 13·6, 14·1; width of braincase 10·5, 10·3; mastoid width 11·0, 11·5; c^1–c^1 (alveoli) 4·8, 5·1; m^3–m^3 8·0, 8·3; c–m^3 9·2, 9·9; length complete mandible from condyles 16·1, 17·3; length right ramus from condyle 16·7, 17·9; c–m_3 10·1, 10·9.

Megaderma spasma celebensis Shamel, 1940

Megaderma spasma celebensis Shamel, 1940 : 352. Likoepang, Sulawesi.

Specimens examined. C Sulawesi: 3♀♀, 2 ♂♂ BM(NH) 82.23–27 Ganda Ganda, 1° 57′ S, 121° 21′ E; 5 ♂♂, 3 ♀♀ Songinbau, 1° 46′ S, 121° 43′ E (all in alcohol, skulls of BM(NH) 82.24–27, 82.29–31, 82.33, 82.35 extracted; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. Andersen & Wroughton (1910) and Andersen (1918) referred specimens of *M. spasma* (Linnaeus, 1758) from Sulawesi and from the Philippine Islands to the nominate subspecies, also known from its type locality, Ternate Island in the northern Moluccas. Later, Shamel (1940) separated Sulawesian material as *M. s. celebensis* on account of its generally smaller skull and the absence of any distinct contrast in colour between the dorsal and ventral surfaces of the body. Tate (1941*b*) who evidently had not seen the account by Shamel considered specimens from Sulawesi inseparable from those from Java, presumably *M. s. trifolium.*

This series of Sulawesian specimens from 'Operation Drake' confirms the small cranial size noted by Shamel (1940) when describing *celebensis*: all agree in size with those from Sulawesi measured by this author and are rather smaller than the Philippine specimens that he examined. They are also somewhat smaller than a series of *M. s. trifolium* from Java.

Measurements: length of forearm (13) 52·2–57·1; length of ear (13) 35·3–37·4; length of tibia (13) 29·2–30·5; greatest length of skull (9) 23·9–24·4; condylocanine length (9) 21·1–21·6; least interorbital width (9) 3·7–4·0; zygomatic width (9) 13·3–14·0; width of braincase (9) 9·9–10·7; mastoid width (8) 10·5–11·0; c^1–c^1 (alveoli) (9) 4·6–5·0; m^3–m^3 (9) 7·4–8·1; c–m^3 (9) 8·8–9·3; length complete mandible from condyles (9) 15·4–16·1; length right ramus from condyle (9) 16·2–16·6; c–m_3 (9) 9·9–10·3. Fourteen examples of *M. s. trifolium* from Java have a condylocanine length of 21·8–23·4 and a length c–m^3 of 9·3–9·8: three from Kangean Island are of similar size with corresponding measurements of 21·8–22·5 and 9·2–9·5.

RHINOLOPHIDAE

Rhinolophus celebensis celebensis Andersen, 1905

Rhinolophus celebensis Andersen, 1905*a*: 83, pl. 3, figs. 4a, 4b, Makassar, S Sulawesi

SPECIMENS EXAMINED. C Sulawesi: ♀ BM(NH) 82.36 R Ranu, 1° 51′ S, 121° 30′ E; 5 ♂♂, 5 ♀♀ BM(NH) 82.37–46 Songinbau, 1° 46′ S, 121° 43′ E; ♀♀ BM(NH) 82.47–48 Taronggo, 1° 44′ S, 121° 40′ E: ♂, ♀ BM(NH) 82.49–50 Kabalo, Mt. Tambusisi, c. 300 m, 1° 40′ S, 121° 20′ E (all in alcohol, skulls of BM(NH) 82.36–37, 82.39–40, 82.48, 82.50 extracted; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. These specimens agree favourably with the holotype of *R. c. celebensis* and with the limited sample of this taxon in the collections of the British Museum (Natural History). They supplement the records of *celebensis* from various localities in Sulawesi by Andersen (1905*a*), Tate & Archbold (1939) and Bergmans & Rozendaal (1982). Measurements: length of forearm (15) 39·7–43·4; condylocanine length (6) 15·5–16·0; supraorbital length (junction of supraorbital crests to nares) (6) 5·0–5·1; palatal length (6) 2·0–2·3; length rostral inflations (6) 1·9–2·1; width rostral inflations (6) 3·1–3·6; width of rostrum (6) 4·6–5·0; least interorbital width (6) 2·1–2·4; zygomatic width (6) 8·7–9·0; width of braincase (6) 7·4–7·7; mastoid width (6) 8·4–8·7; c^1–c^1 (alveoli) (6) 4·2–4·6; m^3–m^3 (6) 6·3–6·5; c–m_3 (6) 6·8–7·1; length complete mandible from condyles (5) 11·6–11·7; length right ramus from condyle (5) 11·9–12·0; c–m_3 (6) 6·8–7·1.

DISCUSSION. Goodwin (1979) in describing *parvus* from the island of Timor discussed the relationships of *celebensis* to *borneensis* Peters, 1861 from Borneo and to *javanicus* Andersen, 1918 from Java, concluding that all belonged to the same species, *R. borneensis.* This author remarked that the most useful taxonomic features of the skull in the *borneensis* group (sic) are the size and shape of the anterior median nasal inflations, the width of the interorbital constriction, and the position of the junction of the supraorbital crests, characters also used for the most part by Andersen (1905*a*) in his classic study of the complex to which these forms belong, the *simplex* group of Andersen, 1905*a* or *megaphyllus* group of Andersen, 1918, later renamed the *ferrumequinum* group by Tate & Archbold, 1939. Apart from those already mentioned, named taxa immediately relevant to this question also

include *importunus* Chasen, 1939 from eastern Java, *madurenesis* Andersen, 1918 from the nearby island of Madura, *spadix* Miller, 1901 from the South Natuna and Karimata Islands and *chaseni* Sanborn, 1939 from Con Son Island (Pulo Condore), off the southeastern coast of Indochina.

The small series of *celebensis* reported here confirms the general similarity to *borneensis* suggested by Andersen (1905*a*) and formalised by Goodwin (1979) in considering the two conspecific. There is some variability in the size and shape of the anterior median narial inflations: the holotype (BM(NH) 97.1.3.19) of *celebensis* has rather short inflations which in other examples are longer antero-posteriorly. On the whole the anterior narial inflations are a little smaller than those of a limited sample of *borneensis* but the smallest of *borneensis* are closely similar to the largest of *celebensis*. The narial inflations of *celebensis* are less inflated than those of *R. keyensis* Peters, 1871 from the Molucca Islands to the east, although generally similarly narrow, and in this species the facial part of the skull tends to be longer than in *celebensis*, with the junction of the supraorbital and the sagittal crests lying at a point more or less behind the middle of the orbit rather than more or less in front of it. As Goodwin (1979) pointed out, *borneensis* differs more from *celebensis* and its immediate allies *javanicus* and *parvus* than these do from each other in its more strongly arched fronto-parietal area and more bulbous occipital region, although these characters are less clear when series are examined. In addition to the generally larger and wider narial inflations and more inflated braincase, *borneensis* and its close allies *spadix* and *chaseni* are usually a little larger cranially than any of the more easterly forms. Goodwin (1979) omitted any mention of *madurensis* in his account of *parvus*, to which in fact it is similar in size and structure. Comparison suggests that details of coloration apart (the sole *parvus* available is in alcohol) the two may be separated only by the slightly less globular narial inflations of *madurensis*. It should be noted that the 'condylocanine length' given by Goodwin (1979 : 107, tab. 1) for *parvus, javanicus, celebensis* and *borneensis* is in fact the greatest length of the skull.

Through the courtesy of Dr C. J. Smeenk of the Rijksmuseum van Naturlijke Historie, Leiden it has been possible to examine one (RMNH 15320) of the original specimens of *importunus* Chasen, 1939 from Tjiawitali, near Wijnkoops Bay, east Java. Further comparison confirms the view expressed by Chasen in the original account that cranially it is very like *borneensis*, with which it agrees in size, inflated braincase and bulbous occipital region, differing in these features from *javanicus*, known so far from west Java. As Chasen pointed out, it is clearly very closely related to *borneensis* to which it is very similar. Although admitting this close relationship and also indicating clearly that it could not be placed with *javanicus* he was reluctant to unite *importunus* with *borneensis* largely because the known occurrences of *importunus* in eastern Java and of *javanicus* in western Java might imply that they replaced each other geographically. However, further examination leaves little doubt that *importunus* must be allied with *borneensis*.

For these reasons and in view of the limited material as yet available for some of the forms involved, I prefer to retain *borneensis* and *celebensis* as distinct species, the latter to include *javanicus, madurensis* and *parvus* as subspecies, although the very small size of *madurensis* and *parvus* might justify their specific distinction (as *madurensis*) from *celebensis*. *Rhinolophus borneensis* includes *spadix, chaseni* and *importunus* as subspecies, the last possibly occurring sympatrically with *R. celebensis javanicus* in Java. Possibly the very small *virgo* Andersen, 1905*a* from Luzon Island, Philippine Islands should also be associated with *R. celebensis*, while *nereis* Andersen, 1905*a* from Pulo Siantan, Anamba Islands evidently represents *R. borneensis*, but is considerably larger.

Rhinolophus pusillus pusillus Temminck, 1834

Rhinolophus pusillus Temminck, 1834 : 28, pl. 1, fig. 9. Java.

SPECIMENS EXAMINED. Borneo: ♂ BM(NH) 78.2491 About 25 km inland from Sangkulirang, a small port at the mouth of the R Baa, East Kalimantan, c. 0° 59′ N, 117° 55′ E (in alcohol, skull extracted; coll. S. M. Jeffrey).

REMARKS. Although known from India and southern China to the Anamba Islands, Java and Madura Island, *R. pusillus* has not been recorded hitherto from Borneo. In size this specimen agrees closely with those from Java and the smaller islands of Madura, Tioman and Penang recorded by Hill (1974) and also with the skin from Aur (=Aor) Island reported earlier by this author (1960) as of *R. minutillus* Miller, 1906*a* (=*R. pusillus minutillus*, originally described by Miller (1900) as *R. minutus*) from Siantan Island, Anamba Islands. Specimens from the Malayan offshore islands, Madura Island and Borneo all seem referrable to the nominate subspecies *R. p. pusillus*.

Measurements of BM(NH) 78.2491: length of forearm 37·0; greatest length of skull to canine 15·6; condylocanine length 13·8; width across rostral swellings 4·1; least interorbital width 2·1; zygomatic width —; width of braincase 7·0; mastoid width 7·9; c^1–c^1 (alveoli) 3·8; m^3–m^3 5·8; length complete mandible from condyles 9·9; length right ramus from condyle 10·3; c–m_3 6·2.

Rhinolopus euryotis tatar Bergmans & Rozendaal, 1982

Rhinolophus tatar Bergmans & Rozendaal, 1982 : 170. Moinakom River, Dumoga Nature Reserve, North Sulawesi, 525 m, 0° 41′ M. 124° 03′ E.

SPECIMENS EXAMINED. C Sulawesi: 9 ♂♂, 17 ♀♀ BM(NH) 82.51–76 Songinbau, 1° 46′ N, 121° 43′ E; 12 ♂♂, 7 ♀♀ BM(NH) 82.77–95 Taronggo, 1° 44′ N, 121° 40′ E; ♀ BM(NH) 82.96 R Ranu, 1° 51′ S, 121° 30′ E (all in alcohol, skulls of BM(NH) 82.51, 82.53–55, 82.78–82, 92.84–88, 82.90 extracted; coll. B. H. Gaskell, 'Operation Drake').

S Sulawesi: ♂♂ BM(NH) 82.97–98 Lalonggasu Meeto (Tomba Watu Cave), 18 km from Kendari Central (in alcohol, skull of BM(NH) 82.98 extracted; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. This subspecies (length of forearm 48·4–53·2) includes the smallest of *R. euryotis*, with broad noseleaf that covers the muzzle, the anterior leaf with a very shallow emargination, the margins of this notch thickened, the thickening extending posteriorly as narrow ridges over the leaf to delimit a shallow longitudinal median groove terminating at the edge of the narial depression in a small, thickened, posteriorly directed projection. The internarial region is expanded laterally into a wide, angular cup and the sella is wide, slightly ovate-pyriform in frontal outline. Its connecting process is high, arcuate and inserted anteriorly at or near the upper margin of the sella, with a lower insertion posteriorly on the intermediate part of the leaf. The lancet is high, cuneate, with an acute point, and is densely pilose. The ears are large, extending to the tip of the muzzle when laid forward; their anterior or medial margin is convex beneath a small, acutely pointed tip, their posterior margin concave just beneath tip, otherwise convex with a well developed more or less rectangular antitragal lobe.

The skull is relatively small with short, broad rostrum and elongate braincase, the anterior median rostral inflations relatively large, swollen, projecting, high and rounded and there is a shallow triangular frontal depression bounded laterally by moderate suprorbital ridges. The median cranial crest is well developed, more evident anteriorly than posteriorly and the zygomata are not greatly expanded, the zygomatic width subequal to or only slightly exceeding the mastoid width. The palate is short, its length one third or less the length of the maxillary toothrow and the cochleae are expanded, only narrowly separated basioccipitally. The anterior upper premolar (pm^2) is small, in the toothrow, not compressed and the second lower premolar (pm_3) is very small, extruded from the row.

Externally this subspecies may be distinguished from the other described forms of *R. euryotis* by its shorter forearm, generally smaller size, and, for the most part, by its narrower sella which is usually less expanded laterally and often less ovate-pyriform than in the other members of the species. In the majority of its features it is most similar to *R. e. aruensis* Andersen, 1907*b* (Aru Islands) or to *R. e. burius* Hinton, 1925 (Buru Island, Molucca Islands) but has a less massive and narrower rostrum, slightly less inflated braincase and slightly smaller and less massive teeth, especially the canines. Its shorter forearm and

narrower sella provide obvious features distinguishing *tatar* from *R. e. euryotis* Temminck, 1835 (Amboina and Ceram Islands, Molucca Islands), *R. e. timidus* Andersen, 1905*b* (Batchian Island and New Guinea) and from *R. e. praestans* Andersen, 1905*b* (Kei Islands): in these, especially in *R. e. euryotis,* the noseleaf is more fleshy and the features of the antenarial region more greatly developed, with a more emphatic longitudinal groove across the anterior leaf terminating in a larger posterior projection.

Discussion. Tate & Archbold (1939) provided the first reports of *R. euryotis* from Sulawesi, recording specimens from the south and southeast of the island. These authors thought Sulawesian specimens most probably referable to *R. e. euryotis,* although apparently they had not examined specimens from Amboina, its type locality, or any of the other associated islands in the Moluccas. They relied instead on the description of *euryotis* by Temminck (1835) and in particular upon his statement that the forearm in Amboinese specimens measured '2 pouces' which they converted as 50·8 mm. They remarked that the treatment by Andersen (1905*b*) of *euryotis* was somewhat invalidated by the assumption that the forearm of the nominate subspecies was 56 mm in length, against this lower figure given by its describer, and postulated larger subspecies (*praestans, timidus* and *burius)* in the Kei Islands, Batchian and New Guinea, and on Buru, with smaller subspecies (*aruensis, euryotis*) in the Aru Islands and in Amboina and Sulawesi. Specimens reported by these authors from Sulawesi agree closely in size with *tatar* as described by Bergmans & Rozendaal (1982) and with the specimens reported here.

A small series of *R. euryotis* in the collections of the British Museum (Natural History) from Amboina and the nearby island of Ceram has forearm lengths ranging from 55·1–58·4, considerably larger than the value assumed by Tate & Archbold (1939) for Amboinese specimens. In fact, these authors have converted Temminck's measurements as English pouces (one pouce = 25·4 mm), but Temminck used the French equivalent (one pouce = 27·07 mm) which when converted gives a value of 54·1 mm, much closer to the forearm lengths of Amboinese specimens available in London. This deduction is confirmed by Bergmans & Rozendaal (1982) who quote approximate forearm lengths (measured by Dr C. J. Smeenk) of 54·9, 55·1 and 54·5 for the three syntypes of *euryotis* in the Rijksmuseum van Natuurlijke Historie, Leiden.

The specimens reported here agree exactly with the description of *tatar* by Bergmans & Rozendaal, who considered it a distinct species, morphologically nearest to *R. arcuatus* Peters, 1871. This latter species is widely distributed from Luzon Island (*arcuatus*) and Mindanao Island (*exiguus* Andersen, 1905*b*) in the Philippine Islands to Borneo (*proconsulis* Hill, 1959), Sumatra (*beccarii* Andersen, 1907*c*), Buru Island in the Molucca Islands (*toxopeusi* Hinton, 1925), Wetter Island in the Flores Sea (*angustifolius* Sanborn, 1939) (thought probably a distinct species by Bergmans & Rozendaal, 1982) and New Guinea (*mcintyrei* Hill & Schlitter, 1982). Although very similar both externally and cranially to *R. euryotis,* its anterior noseleaf lacks the characteristic broad median groove of this species flanked by swollen longitudinal ridges and extending across the leaf to the internarial region, where it terminates at a small projection. Instead, the narrow anterior emargination of the leaf is prolonged posteriorly as a narrow linear groove onto the face of the leaf, this groove extending less than halfway to the internarial region. Moreover, although the largest of *R. arcuatus* (*proconsulis, mcintyrei*) have forearm lengths that reach or overlap those *tatar* the skull is slightly smaller, with smaller teeth.

When first examined the specimens reported here were referred to *R. euryotis*: although they differ sharply from *R. e. euryotis* in size and in the lesser degree of development of the antenarial structures they are closely approached in the former respect by *R. e. aruensis* and in the latter by this subspecies and to some extent by *R. e. burius.* Specimens of *R. e. praestans* and *R. e. timidus* are nearer to *R. e. euryotis* in these features. As Bergmans & Rozendaal (1982) pointed out, in comparison with *R. euryotis* the teeth of *tatar* are not small, the zygomatic width is not narrowed and the sagittal crest is not low. Consequently, they considered the skull of *tatar* to display a tendency towards *R. euryotis* although on its

Table 4 Selected measurements of *Rhinolophus euryotis* (numbers of specimens examined in parentheses)

	R. e. tatar	*R. e. euryotis*	*R. e. burius*	*R. e. praestans*	*R. e. aruensis*	*R. e. timidus*	Kiriwina I (ex Koopman, 1982)	New Britain (ex Koopman, 1982)	New Britain (ex Smith & Hood, 1981)
Length of forearm	(48) 48·4–53·1	(11) 55·1–58·4	55·1	(8) 55·5–58·0	53·1, 54·1	(11) 53·9–57·3	(1) 52	51	57·4
Width of sella	(48) 2·8–3·6	3·7, 3·8	3·5	(5) 3·9–4·1	3·7, 3·9	(7) 3·9, 4·5			
Condylocanine length	(16) 19·5–21·0	(6) 20·9–22·5	21·0	(8) 21·4–22·4	20·8, 21·0	21·3, 22·5	(2) 20·1, 20·4	21·1	
Rostral width	(16) 5·8–6·5	(7) 6·5–7·4	6·7	(8) 6·6–7·1	6·6, 6·6	(3) 6·6–6·9			
Zygomatic width	(15) 10·7–11·3	(6) 11·7–12·6	12·2	(8) 12·0–12·6	11·5, 11·6	(3) 11·4–12·1			
Width of braincase	(16) 9·1–9·8	(6) 8·9–10·6	10·2	(8) 10·0–10·4	10·0, 10·2	(3) 9·9–10·1			
Mastoid width	(15) 10·4–11·2	(6) 11·0–11·7	11·1	(8) 11·1–11·6	11·0, 11·3	11·2, 11·4	(2) 10·7, 10·9	11·4	
m^3–m^3 (crowns)	(16) 8·1–8·4	(6) 8·7–9·3	9·0	(8) 9·1–9·5	8·8, 9·0	(3) 8·7–9·2	(3) 8·1–8·4	8·5	
m^3–m^3 (alveoli)	(16) 7·7–8·2	(7) 8·5–9·1	8·8	(8) 8·7–9·1	8·4, 8·5	(3) 8·4–8·6			
c–m^3	(16) 8·7–9·4	(7) 9·5–10·2	9·4	(8) 9·5–10·0	9·4, 9·6	(3) 9·4–9·8	(3) 8·8–9·2	9·5	

external features they considered *tatar* to be nearest to *R. arcuatus.* However, Bergmans & Rozendaal (1982) appear to have made no direct comparison with any representative of *R. arcuatus,* and of *R. euryotis* only with examples of the nominate subspecies from Amboina. Comparison with all but *angustifolius* among *R. arcuatus,* and with all of the described form of *R. euryotis* leads me to the conclusion that *tatar* is best considered a subspecies of this latter, a finding that confirms the allocation of similar specimens from Sulawesi to *R. euryotis* by Tate & Archbold (1939).

In view of the relatively small size of *R. e. tatar* it is of some interest to remark that Koopman (1982) has reported three specimens of *R. euryotis* from Kiriwina island, off eastern Papua New Guinea that are of similar size (Table 4), and one that is little larger (approaching *R. e. timidus*) from New Britain, but Smith & Hood (1981) have also recorded a much larger example from the same island. Koopman (1982) was inclined to doubt the validity of some at least of the subspecies of *R. euryotis* then recognised.

HIPPOSIDERIDAE

Hipposideros bicolor bicolor (Temminck, 1834)

Rhinolophus bicolor Temminck, 1834: 19, pl. 1, fig. 3; 1835: 18 (further description). Lectotype designated and type locality restricted to Anjer coast, northwestern Java by Tate (1941*a*).
Hipposideros javanicus Sody, 1937*a*: 215. Babakan, Kroja, Tjilatjap, central Java.

Specimen examined. W Java: ♀ Rijksmuseum van Natuurlijke Historie 29304 Tjilatjap (skin, skull; coll. 25 October 1929, apparently by H. J. V. Sody).

Remarks. This specimen appears to be one of those recorded by Sody (1930) as *H. galeritus longicauda* (Peters, 1861). However, the noseleaf lacks the lateral supplementary leaflets characteristic of *H. galeritus* and its allies and the specimen proves on further examination to represent *H. bicolor bicolor.* Dorsally, it is pale brown, the hairs with creamy or whitish bases that show through the darker tipping: the throat and chest are whitish, the remainder of the ventral surface brownish buff. The skull is elongate in outline, the rostrum and palate sharply tapered anteriorly; the narial swellings are only slightly inflated and there is a low sagittal crest; the zygomatic width is less than the mastoid width, the zygoma robust with low jugal eminence; the interparietal region is swollen and rather pronounced; the palation is shallowly V-shaped with wide mesopterygoid fossa; the sphenoidal bridge is wide, partially concealing elongate lateral apertures and there is a shallow oval sphenoidal depression; the cochlea are a little wider than their distance apart. The anterior upper premolar (pm^2) is very small, slightly extruded into a recess between the canine and the second upper premolar (pm^4); the posterior ridge of m^3 is about one half the length of the anterior ridge; the crown area of the outer lower incisors is very slightly greater than the crown area of the inner pair; anterior lower premolar (pm_2) threequarters the length and two thirds the height of the second lower premolar (pm_4) and two thirds its crown area.

Measurements: length of forearm 45·8; ear not measurable; length of tail c. 39; length of tibia c. 21; length of foot (c. u.) c. 8; greatest length of skull 19·0; condylobasal length 17·0; condylocanine length 16·8; basal length 14·6; palatal length 6·5; width across rostral swellings 4·8; least interorbital width 2·9; zygomatic width 9·3; width of braincase 8·7; mastoid width 9·6; c^1–c^1 (alveoli) 4·1; m^3–m^3 6·1; c–m^3 6·5; m^{1-3} 4·0; length complete mandible from condyles 11·7; length right ramus from condyle 12·0; c–m_3 7·0.

Discussion. This example agrees closely with the account by Tate (1941*a*) of the lectotype of *H. bicolor* (Temminck, 1834) in the Rijksmuseum van Natuurlijke Historie and with the description of *H. javanicus* by Sody (1937*a*), thought by Tate (loc. cit.) and by Hill (1963) to be a synonym of *bicolor.* Sody almost concurrently (1937*b*) recorded *javanicus* from the island of Banka: the specimen that he reports is slightly smaller in some respects either than the holotype of *javanicus* or the specimen of *bicolor* from Java reported here. There seems little doubt that *javanicus* must be considered a synonym of *H. b. bicolor.*

Hipposideros ater aruensis Gray, 1858

Hipposideros aruensis Gray, 1858 : 107. Aru Islands.

SPECIMENS EXAMINED. Papua New Guinea: ♀♀ BM(NH) 73.2036–2037 (both yg.) Kairiru Cave, near St Xavier's Mission, Kairiru I, near Wewak, East Sepik, c. 3° 21′ S, 143° 36′ E (in alcohol; coll. Aberdeen University Exploration Society Expedition to New Guinea, 1973); ♂ BM(NH) 80.612 S Tunnel, Bulolu Gorge, Wau, Morobe (in alcohol; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. Little material is available from the more eastern part of the range of *H. ater* and for the present, following Hill (1963), specimens from New Guinea are referred to *H. a. aruensis*. McKean (1972) records specimens from Ambunti, Papua New Guinea. Length of forearm (BM(NH) 80.612) 40·9.

Hipposideros maggietaylorae erroris Smith & Hill, 1981

Hipposideros maggietaylorae erroris Smith & Hill, 1981 : 14. Yaguam Sulfur Cave, 5 miles S and 3 miles W of Madang, Madang Province, Papua New Guinea, 5° 17′ S, 145° 45′ E.

SPECIMENS EXAMINED. Papua New Guinea: 4 ♂♂ (2 yg.), 4 ♀♀ BM(NH) 73.2038–2045 Kairiru Cave, near St Xavier's Mission, Kairiru I, near Wewak, East Sepik, c. 3° 21′ S, 143° 36′ E (in alcohol; coll. Aberdeen University Exploration Society Expedition to New Guinea, 1973); ♀♀ (1 yg.) BM(NH) 75.1863–1865 St Xaviers, Kairiru I (in alcohol, skull of BM(NH) 75.1864 extracted; coll. A. M. Jones, Aberdeen University Exploration Society); ♂, ♀ BM(NH) 78.875–876 About 10 km S of Madang, 5° 15′ S, 145° 45′ E (in alcohol; coll. P. A. Morris); ♂, ♀♀ (1 yg.) BM(NH) 80.638–643 War Tunnel, Salamana, Morobe, 7° 03′ S, 147° 03′ E (in alcohol; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. These specimens are listed by Smith & Hill (1981) in their account of *H. maggietaylorae*: those obtained by 'Operation Drake' are recorded erroneously as BM(NH) 80.516–522 (the suffixes in fact their collection numbers).

Hipposideros ridleyi Robinson & Kloss, 1911

Hipposideros ridleyi Robinson & Kloss, 1911 : 241 Botanic Gardens, Singapore.

SPECIMEN EXAMINED. Borneo: ♂ BM(NH) 82.160. Sepilok Forest Reserve, Sabah (in alcohol; coll. P. Zborowski).

REMARKS. This specimen is the first of *H. ridleyi* to be recorded from Borneo, the species being otherwise known from the type locality and from Selangor on the Malayan mainland (Medway, 1978). It may be easily recognised by its very large sub-triangular ears (length from meatus c. 21–23) broad noseleaf that lacks lateral supplementary leaflets, the expansion of the internarial septum to form a concave, saucer-like disc between and in front of the nostrils and by its high posterior leaf, the upper part supported by three septa defining four deep pockets. Length of forearm in the Bornean example 48·1, in the holotype (BM(NH) 61.329) 47·3 and in a specimen (BM(NH) 75.2000) from a locality between Kuala Kangsar and Rawang, Selangor, 48·5.

Hipposideros cervinus cervinus (Gould, 1863)

Rhinolophus cervinus Gould, 1863 : pl. 34, letterpress. 'Caves on Albany Island' (label on skin of holotype). Cape York, Queensland, Australia.

SPECIMENS EXAMINED. C Sulawesi: 8 ♂♂, 5 ♀♀ BM(NH) 82.99–111 Taronggo, 1° 44′ S, 121° 40′ E; ♀♀ BM(NH) 82.112–113 R Ranu, 1° 51′ S, 121° 30′ E (all in alcohol, skulls of BM(NH) 82.100, 82.109–110, 82.112 extracted; coll. B. H. Gaskell, 'Operation Drake').

S Sulawesi: ♀♀ BM(NH) 82.114–115 Lalonggasu Meeto (Tomba Watu Cave), 18 km from Kendari Central (in alcohol, skull of BM(NH) 82.115 extracted; coll. B. H. Gaskell, 'Operation Drake').

Papua New Guinea: ♂♂ BM(NH) 75.1866–1867 Wageo I, Schouten Is, East Sepik; ♀ BM(NH) 75.1868 Kadovar I, Schouten Is; ♂, 3 ♀♀ BM(NH) 75.1869–1872 East Sepik (all in alcohol; coll. A. M. Jones, Aberdeen University Exploration Society); ♂ BM(NH) 76.386 Karkar I, Madang (in alcohol; coll. H. King); ♀ BM(NH) 78.877 About 10 km N of Baku, Gogol Valley, Madang, c 40 m (flat skin); 4 ♂♂, 7 ♀♀ BM(NH) 78.878–888 8 km W of Baku, c. 50 m; (in alcohol) (all coll. P. A. Morris); ♀♀ BM(NH) 80.607–611 N Tunnel, Bulolu Gorge, Wau, Morobe, 7° 19′ S, 146° 44′ E; ♂ BM(NH) 80.612 S Tunnel, Bulolu Gorge; ♂ BM(NH) Lae, Morobe, 6° 49′ S, 147° 03′ E; ♀♀ BM(NH) 80.614–617 Buso, Morobe, 7° 17′ S, 147° 08′ E; 6 ♂♂, 8 ♀♀ BM(NH) 80.618–631 Siboma, Morobe; 2 ♂♂, 4 ♀♀ BM(NH) 80.632–637 Coastal cave W of Kui Village, Morobe, 7° 22′ S, 147° 11′ E (all in alcohol; coll. B. H. Gaskell, 'Operation Drake').

New Hebrides: 2 ♂♂, 2 ♀♀ BM(NH) 73.1334–1337 Grotte Montmartre, Port Vila, Efate I, 20 m; 6 ♂♂, 3 ♀♀ BM(NH) 73.1338–1346 Mission Montmatre, Port Vila; 4 ♂♂, 2 ♀♀ BM(NH) 73.1347–1352 'Pig Cave', Harris Plantation, N coast Efate I, 40 m; ♂, ♀ BM(NH) 73.1353–1354 'Pig Cave', Narabut Camp, Efate I; 3 ♂♂, 3 ♀♀ BM(NH) 73.1355–1360 Lomboh Cave, Litzlitz, Port Stanley Bay, Malekula I, 5 m; ♂, 3 ♀♀ BM(NH) 73.1361–1364 Lipelip Cave, Amok, Malekula I, 440 m; 2 ♂♂, ♀ BM(NH) 73.1365–1367 Aouta Plantation, Aore I; ♂♂ BM(NH) 73.1368–1369 New Hebrides (all in alcohol. obtained by Earl of Cranbrook, Royal Society Expedition to the New Hebrides, 1973).

REMARKS. Specimens from Sulawesi appear to be the first of *H. c. cervinus* to be recorded as such from that island, although earlier records of *H. galeritus galeritus* from Gimpoe or Bada and Peleng Island by Shamel (1940) and of *E. galeritus celebensis* from Talassa and Banti-moerang by Tate (1941*a*) may refer in fact to *cervinus*. A recent study at the British Museum (Natural History) by Jenkins & Hill (1981) has indicated that two species, namely *H. galeritus* Cantor, 1846 (including *insolens* Lyon, 1911 as a subspecies) and *H. cervinus* (including *labuanensis* Tomes, 1859*a* as a subspecies) occur in Borneo. *Hipposideros celebensis* Sody, 1936 based on specimens initially referred by this author (1930) to *H. galeritus galeritus,* has from the measurements given by Sody a broader braincase and shorter toothrow than the Sulawesian specimens here referred to *H. cervinus,* but Jenkins & Hill found two paratypes of *celebensis* to have longer toothrows and narrower zygomatic and braincase widths than Sody's measurements indicated. The paratypes unquestionably represent *H. cervinus* and these authors suggested from the available evidence that only *H. c. cervinus* occurs in Sulawesi, specimens from that island approaching the more easterly nominate subspecies rather than the geographically nearer Bornean subspecies *H. c. labuanensis.*

Measurements of specimens from Sulawesi: length of forearm (17) 45·0–49·1; condylocanine length (5) 14·3–14·9; width of rostrum (5) 4·9–5·1; least interorbital width (5) 2·5–2·8; zygomatic width (5) 8·8–9·1; width of braincase (5) 7·7–8·0; mastoid width (5) 8·6–8·9; c^1–c^1 (alveoli) (5) 3·7–3·9; m^3–m^3 (5) 6·0–6·1; c–m^3 (5) 5·8–6·0; length complete mandible from condyles (5) 10·3–10·8; length right ramus from condyle (5) 10·7–11·1; c–m_3 (5) 6·3–6·4.

Hipposideros diadema pullatus Andersen, 1905

Hipposideros diadema pullatus Andersen, 1905*c*: 498. Haveri, Papua New Guinea, 700 m.

SPECIMENS EXAMINED. Papua New Guinea: ♂ BM(NH) 78.889 (flat skin), ♀,♂ 78.890–891 (in alcohol) About 10 km S of Madang (coll. P. A. Morris).

Hipposideros dinops pelingensis Shamel, 1940

Hipposideros pelingensis Shamel, 1940 : 353. Peling (= Peleng) I. E of Sulawesi.

SPECIMENS OBTAINED. S Sulawesi: ♂, 2 ♀♀ BM(NH) 82.116–118 Lalonggasu Meeto (Tomba Watu Cave), 18 km from Kendari Central (in alcohol, skulls of BM(NH) 82.117–118 extracted; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. Shamel (1940) diagnosed *pelingensis* solely on the basis of its shorter tibia (length 38·2–41·0) when compared with *H. dinops* Andersen, 1905*c* from the Solomon Islands. Tate (1941*a* : 376) recorded *pelingensis* from Talassa, (Maros), south Sulawesi, listing (p. 391) the specimens as *H. diadema pelingensis* although (p. 376) comparing and associating *pelingensis* with *dinops*. Hill (1963) considered *pelingensis* a subspecies of *H. dinops* but had seen no examples of the Sulawesian form.

These specimens agree favourably in size and structure with the nominate subspecies from the Solomon Islands but the rostrum is very slightly narrower, the upper canines a little smaller at the base and the toothrows a little shorter. However, in most of these features they closely resemble the smallest of the available specimens from the Solomons, an example (BM(NH) 67.2118) from Malaita Island reported by Hill (1971*a*) who gave measurements of *H. d. dinops* and discussed variation in this subspecies.

External measurements: length of forearm (3) 93·4–96·9; length of tibia (3) 39·9–40·9. Cranial measurements (♂ BM(NH) 82.117, ♀ 82.118): greatest length of skull 36·5, 36·0; condylobasal length 32·4, 32·4; condylocanine length 31·5, 31·4; palatal length 13·2, 13·0; rostral width 10·2, 9·9; anteorbital width 10·0, 9·0; length of anterorbital foramen 2·8, 2·7; width of anteorbital foramen 0·7, 0·8; least interorbital width 3·6, 3·9; zygomatic width 20·8, 20·2; width of braincase 13·9, 13·7; mastoid width 16·7, 16·1; c^1–c^1 (alveoli) 9·3, 8·9; m^3–m^3 12·7, 12·7; c–m^3 13·8, 13·4; length c^1 4·12, 3·97; width c^1 2·83, 2·85; length complete mandible from condyles 24·7, 24·5; length right ramus from condyle 25·5, 25·4; top of condyle–tip of angular process 5·8, 6·1; bottom of condyle–tip of coronoid process 7·2, 7·6; tip of angular process–tip of coronoid process 10·9, 11·7; c–m_3 15·6, 14·9.

DISCUSSION. Specimens of *H. d. pelingensis* are of particular interest in connection with the very large *H. inexpectatus* Laurie & Hill, 1954, no material of *pelingensis* being available in London when this was described. Direct comparison shows *pelingensis* to be considerably smaller, with lower, narrower rostrum, much less developed sagittal and lambdoidal crests, less expanded zygomata and much smaller teeth. There is especially a great contrast in the large and heavy mandible of *inexpectatus* and the relatively lighter and by comparison apparently delicate mandible of *pelingensis*. Until recently *H. inexpectatus* was known in the literature solely from its holotype (BM(NH) 25.6.5.19) from Poso, north Sulawesi but Fieler (1981) has reported two further examples, from Gorontalo and Minahassa. They are specimens that have been for many years in the collections of the Staatliches Museum für Tierkunde in Dresden, formerly identified as *H. diadema* (Geoffroy, 1813).

Aselliscus tricuspidatus novehebridensis Sanborn & Nicholson, 1950

Aselliscus tricuspidatus novehebridensis Sanborn & Nicholson, 1950 : 461. Cave on Segond Channel, Espiritu Santo I, New Hebrides.

SPECIMENS EXAMINED. New Hebrides: 15 ♂♂, 8 ♀♀ BM(NH) 73.1370–1392 Aouta, Aore I; 2 ♂♂, 2 ♀♀ BM(NH) 73.1393–1396 Aouta Plantation, Aore I; ♂, ♀ BM(NH) 73.1397–1398 Hog Harbour, Espiritu Santo I, 150 ft; 3 ♂♂, 2 ♀♀ BM(NH) 73.1399–1403 Senwar Cave, Tenmial, NW coast of Malekula I, 40 m (BM(NH) 73.1393, 73.1396 skins, skulls, all others in alcohol; obtained Earl of Cranbrook, Royal Society Expedition to the New Hebrides, 1971).

REMARKS. In size (length of forearm 39·8–43·5) these specimens agree with *A. t. novehebridensis* as described by Sanborn & Nicholson (1950) and, indeed, extend the range of forearm length given by these authors. They are generally larger than specimens from the Solomon Islands referred to *A. t. tricuspidatus* (Temminck, 1834) by Hill (1956, 1971*a*) or others from islands in the same group reported by Sanborn & Beecher (1947).

External measurements: length of forearm (20 ♂♂) 39·8–42·2 (41·2), (14 ♀♀) 40·3–43·5 (42·0). Cranial measurements (♂ BM(NH) 73.1396, ♀ 73.1393): greatest length of skull 15·5, 15·7; condylobasal length 13·6, 14·0; condylocanine length 13·2, 13·6; palatal length 2·6, 2·7; rostral width 4·9, 5·0; least interorbital width 1·7, 1·7; zygomatic width 7·9, 7·8; width of braincase 6·1, 6·0; mastoid width 7·1, 7·1; c^1–c^1 (alveoli) 4·0, 3·9; m^3–m^3 5·5, 5·5; c–m^3 5·7, 5·7; length complete mandible from condyles 9·8, 10·0; length right ramus from condyle 10·0, 10·2; c–m_3 6·0, 6·1.

Aselliscus tricuspidatus (Temminck, 1834)

Rhinolophus tricuspidatus Temminck, 1834 : 20, pl. 1, fig. 4. Amboina I, Molucca Is.

Specimen examined. Papua New Guinea: ♂ BM(NH) 78.892 (yg.) 8 km E of Baku, Gogol Valley, Madang, 50 m (in alcohol; coll. P. A. Morris).

Remarks. No attempt has been made to allocate this young specimen to subspecies: in any event little comparative material from New Guinea is available in the collection of the British Museum (Natural History). There is however a substantial representation from the Moluccan islands of Buru and Ceram and from Batchian Island, the Kei Islands, and the Solomon Islands. These are smaller (length of forearm (99) 47·2–42·0; condylocanine length (37) 12·1–13·0; palatal length (43) 2·1–2·5; zygomatic width (41) 6·6–7·3; width of braincase (44) 5·4–5·9; mastoid width (44) 6·3–6·9; c^1–c^1 (alveoli) (45) 3·1–3·7; m^3–m^3 (48) 4·6–5·2; c–m^3 (52) 5·0–5·4) than *A. t. novehebridensis* and are referred to *A. t. tricuspidatus*. According to Koopman (1982), similarly small specimens are found on the east Papuan islands. Specimens reported from Papua New Guinea by McKean (1972) and from West Irian by Koopman (1982), however, are larger and tend to bridge the size differences between *tricuspidatus* and *novehebridensis* or to approach the latter.

Coelops robinsoni Bonhote, 1908

Coelops robinsoni Bonhote, 1908 : 4. Foot of Mt. Tahan, Pahang, Malaya.

Specimen examined. Borneo: ♂ BM(NH) 79.1398 Deer Cave, Gunung Mulu National Park, Sarawak (partially mummified, now in alcohol, skull extracted; found S. Proctor, Royal Geographical Society Expedition to Gunung Mulu, 1977–78).

Remarks. The small leaf-nosed bat *C. robinsoni* is known from two specimens from Malaya, one the holotype (BM(NH) 6.10.4.9) in the British Museum (Natural History), the other (USNM 175000) from Port Swettenham, in the United States National Museum of Natural History, and from a specimen from Teratau Island, off southern Thailand, reported by Chasen (1940). The species was reviewed in some detail by Hill (1972) who pointed out that two specimens referred to *C. robinsoni* by Robinson & Kloss (1915*b*) are in fact *C. frithii*. This Bornean specimen agrees closely with the holotype of *C. robinsoni* but has a very slightly wider skull. The discovery of the species in Borneo perhaps adds some weight to the suggestion by Hill (1972) that *C. hirsuta* (Miller, 1910) from Mindoro Island in the Philippines is closely allied to *C. robinsoni*, which indeed it may represent. Unfortunately, it is so far known only from the holotype skin.

Measurements of BM(NH) 79.1398: length of forearm 36·5; greatest length of skull to canine 14·6; condylocanine length 12·7; rostral width 3·9; least interorbital width 1·9; zygomatic width —; width of braincase —; mastoid width —; c^1–c^1 (alveoli) 3·2; m^3–m^3 5·0; c–m^3 5·0; length complete mandible from condyles 8·6; length right ramus from condyle 8·8; c–m_3 5·5.

VESPERTILIONIDAE

VESPERTILIONINAE

Myotis muricola (?) browni Taylor, 1934

Myotis browni Taylor, 1934 : 288. Near Saub, Cotobato, Mindanao I, Philippine Is.

SPECIMENS EXAMINED. C Sulawesi: ♂, 4 ♀♀ BM(NH) 82.119–123 R Ranu, 1° 51′ S, 121° 30′ E (in alcohol, all skulls extracted; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. These small examples are referred provisionally to *browni,* a small representative of *M. muricola* similar in size to *M. m. caliginosus* (Tomes, 1859) from the southern Himalaya or to *M. m. niasensis* Lyon, 1916 from Nias Island, off west Sumatra. Further material from the Philippines and Sulawesi might lead to the recognition of a Sulawesian subspecies: certainly as represented by these specimens from the Ranu River members of the Sulawesian population are considerably smaller than others of *M. muricola* from Thailand, Malaya, Borneo, Java, the Lesser Sunda Islands, and Amboina. There appears to be no previous record of *M. muricola* as such from Sulawesi.

Measurements of five specimens, except where indicated: length of forearm: 31·4–32·7; greatest length of skull 12·3–13·0; condylobasal length 11·8–12·6; condylocanine length 11·2–12·0; least interorbital width 2·8–3·0; zygomatic width (3) 7·8–8·0; width of braincase 5·9–6·0; c^1–c^1 (alveoli) (5) 3·2; m^3–m^3 5·1–5·4; i^2–m^3 5·4–5·8; c–m^3 4·9–5·3; length complete mandible from condyles 8·8–9·5; length right ramus from condyle 9·0–9·6; c–m_3 5·4–5·8.

DISCUSSION. There is some confusion over the correct name for small *Myotis* with small feet (subgenus *Selysius)* occurring in Indo-Australia, the issue apparently turning on the species to be found in the northern part of the Indian sub-continent. Numerous names have been applied to these small bats with forearm 30–36 in length and with $pm\frac{3}{3}$ reduced but not intruded or only slightly intruded from the toothrows: the major question is whether or not these should be associated with the otherwise Palaearctic species *M. mystacinus* (Kuhl, 1819) or should be considered a distinct species *M. muricola* (Gray, 1846). Indo-Australian names involved are:

Vespertilio muricola Hodgson, 1841 (nom. nud.)	
Vespertilio muricola Gray, 1846	Nepal
Vespertilio siligorensis Horsfield, 1855	Nepal
Vespertilio darjelingensis Horsfield, 1855	
Vespertilio (Pternopterus) lobipes Peters, 1867*b*	Burma
Vespertilio caliginosus Tomes, 1859*b*	India
Vespertilio nipalensis Dobson, 1871*b*	Nepal
Vespertilio blanfordi Dobson, 1871*b*	Himalayas
Vespertilio moupinensis Milne Edwards, 1872	Szechuan
Myotis niasensis Lyon, 1916	Nias I
Myotis meinertzhageni Thomas, 1926	Kashmir
(?) *Myotis latirostris* Kishida, 1932	Taiwan
Myotis browni Taylor, 1934	Mindanao I, Philippine Is.
Myotis herrei Taylor, 1934	Luzon I, Philippine Is.
Myotis muricola orii Kuroda, 1935	Taiwan

Thomas (1915*a*) divided *M. muricola* from a *mystacinus* group on account of its allegedly broader, more solidly built skull, heavier teeth, especially the canines, and the greater intrusion of the posterior of the two small premolars ($pm\frac{3}{3}$). According to this author, *M. muricola* included *lobipes,* while his *mystacinus* group included *caliginosus, blanfordi,*

nipalensis, siligorensis and *darjelingensis*. Thomas recognised two 'forms' within the *mystacinus* group, one with low braincase and canines of normal size to include *caliginosus*, with synonyms *blanfordi* and perhaps *nipalensis*, the other with a high crown and reduced canines to include *siligorensis* and its synonym *darjelingensis*. *Myotis siligorensis* is today recognised as a distinct and valid species.

The entire question was reviewed in some detail by Tate (1941*d*) who was unable to make any certain application of the names that he discussed beyond recognising (p. 543) *muricola* (=*moupinensis*), *caliginosus* (=*blanfordi*) and *nipalensis* (=*meinertzhageni*) as subspecies of *M. mystacinus*, with *siligorensis* a valid species in its own right. Elsewhere (p. 545) Tate considered *herrei* and *browni* probably related to *niasensis* which he thought to be a subspecies of *M. mystacinus*, with the suggestion that *lobipes* may also represent this species. Finally, Tate (p. 564) remarked that he did not believe *muricola* to be the correct subspecific name for any East Indian representative and suggested that all should be referred to *M. mystacinus*: specimens from Sumatra, Java and Borneo he allocated to *niasensis* with the proviso that this might be a synonym of *lobipes*, presumably intending that they should be called *M. mystacinus niasensis*.

Chasen (1940) called most Sundanesian specimens *M. muricola muricola* but employed *niasensis* as a valid subspecies of *M. muricola* for those from Nias Island, while Laurie & Hill (1954) followed the lead given by Tate (1941*d*) in employing *M. mystacinus* but used *muricola* as the subspecific name for specimens from the Lesser Sunda Islands, and, by implication, from much of Sundanesia. Findley (1972) recognised *mystacinus* and *muricola* groups within *Selysius* and considered these forms unlikely to be conspecific as once was thought since Tate (1941*d*) had recorded them sympatrically in Nepal, apparently through a reference to Scully (1887) who reported '*mystacinus*' from that country (later described as *siligorensis*) although in fact Tate listed *muricola* as a subspecies of *mystacinus*. Findley included *meinertzhageni* in *mystacinus* and *caliginosus, blanfordi* and *moupinensis* in *muricola*, with the suggestion that *muricola* also includes the various populations of tropical Asia, having associated *browni, latirostris* and *niasensis* (inter alia) with his *muricola* group. More recently, Corbet (1978) has excluded all but *meinertzhageni* among the Indian forms from any discussion of *M. mystacinus*, considering *muricola* specifically distinct.

The collections of the British Museum (Natural History) indicate that two distinctively coloured *Myotis* (excluding *siligorensis*) occur in the northern part of the Indian subcontinent, although cranially they are very similar. One of these is exemplified by a small series of specimens (BM(NH) 16.7.29. 37–41, 16.7.28.90, part of those reported as *muricola* by Wroughton, 1917) from Hasimara Tea Estate, E bank of Toorsa River, c. 8 miles from Bhutan Hills, Jalpaiguri District, Bhutan Duars, 500–600 ft, c. 26° 50′ N, 89° 20′ E. These are brownish dorsally, the hairs black or blackish brown at the base and for most of their length, tipped with shiny, paler ochraceous brown. Ventrally the specimens are whitish, the hairs black based, tipped with white or creamy white, the black undercolour showing through to a limited extent. The collections also include a similar specimen (BM(NH) 9.7.27.3) from Sirguffara, Kashmir, 6000 ft in which the white ventral tipping is a little less evident, and a further example (BM(NH) 23.9.1.12), reported by Lindsay (1926) as *muricola*, from Chirot, in the Pattan Valley, Lahul, near the junction of Chandra and Bhaga Rivers, 9800 ft with the dorsal pelage more heavily tipped with burnished ochraceous. A specimen (BM(NH) 71.13) in alcohol, from Kokernag, Kashmir evidently also has brownish dorsal pelage and whitish underparts. These specimens clearly represent *M. mystacinus* and agree closely with the description of *M. mystacinus nipalensis* by Dobson (1871*b*) to which they are referred.

Specimens of this type appear to have been the basis of the remark by Allen & Coolidge (1940) that *muricola* of the Nepal–Himalaya foothills has the dorsal pelage tipped with shiny-ochraceous rather than duller brown, with a whitish rather than yellowish ventral surface. Thus in contrasting such specimens with East Indian examples they apparently compared their more eastern specimens with *M. mystacinus* rather than with *muricola* as they assumed. Tate (1941*d*) quotes these authors in support of the distinctiveness of

supposed Himalayan *muricola*: possibly their comment influenced his opinion that *muricola* should not be applied as a subspecific name to any East Indian form.

Tate (1941*d*) and Corbet (1978) suggested that *meinertzhageni* might be synonymous with *nipalensis,* Ellerman & Morrison-Scott (1951) in fact listing it as a provisional synonym of *nipalensis.* However, the holotype BM(NH) 26.3.1.1 of *meinertzhageni* is considerably paler dorsally than the specimens here referred to *nipalensis,* the pelage heavily tipped with creamy white, faintly tinged with ochraceous, the ventral surface with pelage that is white tipped over a black base.

The collections also include further specimens (BM(NH) 23.9.1.13–14, identified as *caliginosus* by Lindsay, 1926) from Samayala, in the Kangra Valley, that evidently represent a smaller, darker form than *M. mystacinus,* its dorsal pelage darker and blacker, less profusely tipped with shiny brown, its ventral pelage tipped with ochraceous brown rather than with whitish, although both dorsally and ventrally the hairs are blackish at the base. Similar dark-bellied specimens in the collections come from other localities in the Punjab (BM(NH) 7.11.21.4, 10.1.18.17–18), Sikkim (BM(NH) 91.10.7.57, 15.9.1.21), Kashmir (BM(NH) 8.7.6.10) and Pakistan (from Murree Hills) (BM(NH) 71.1570–1573) at altitudes from 6500–7600 ft: the highest at which these are represented is by a specimen (BM(NH) 14.7.10.55) from the Pindar Valley at 10 700 ft. All of these specimens agree closely with *caliginosus* or with *blanfordi* which is evidently a synonym of *caliginosus*: in turn this last is similar to but slightly larger than *muricola.* There seems little doubt that these are conspecific and that *M. muricola caliginosus* is the westernmost representative of *M. muricola,* overlapping in parts of its range with *M. mystacinus nipalensis.*

Further east, specimens of *muricola* from Nepal, in wet preservation, have the characteristically dark ventral surface of *caliginosus,* lacking any white tipping. Dry examples from Thailand, Vietnam, Borneo and Java have a brownish dorsal surface similar to that of *caliginosus,* the hairs blackish brown at the base and tipped with ochraceous brown. The ventral surface is buffy brown to greyish black, the hairs having dark bases with buffy brown or greyish buff tips, but often with much of the darker undercolour showing through the paler tipping. Lack of mainland material prevents any proper assessment of possible subspecific variation: as Chasen (1940) pointed out the pattern of size variation in Malaya, Sumatra, Borneo and Java throws doubt on the necessity of recognising more than one Sundanesian subspecies. For the present, therefore, I refer specimens from this area and its many islands except Nias to one subspecies, *M. muricola muricola. Myotis niasensis* Lyon, 1916 is very small and may well justify distinction as *M. muricola niasensis,* while the Philippine forms *herrei* and *browni* also seem separable on similar grounds, together with small examples from Sulawesi.

No attempt has been made in this brief survey to discuss named forms occurring outside the Indo-Australian region, or to examine the relationship of *M. muricola* to any of the other Palaearctic forms now recognised. This question is briefly reviewed by Corbet (1978).

Myotis ater (Peters, 1866)

Vespertilio ater Peters, 1866*a* : 18. Ternate I.
Vespertilio adversus var. *amboinensis* Peters, 1866*b* : 400. Amboina I, Molucca Is.
(?) *Vespertilio australis* Dobson, 1878 : 317. New South Wales, Australia.

SPECIMENS EXAMINED. C Sulawesi: ♂ BM(NH) 82.124 R Ranu, 1° 51′ S, 121° 30′ E (in alcohol, skull extracted; coll. B. H. Gaskell, 'Operation Drake').

Siberut I. Mentawei Is: 2 ♂♂ (1 yg.). 3 ♀♀ BM(NH) 78.2932–2936 Headquarters of Sirimuri R, off Saibi R (in alcohol, skulls of BM(NH) 78.2933–2934 extracted; coll. J. J. Whitten).

REMARKS. Although similar to *M. muricola, M. ater* is larger, with a heavier, wider rostrum and more inflated braincase; pm^3 is small, intruded from the toothrow while pm_3 is slightly intruded, squashed between pm_2 and pm_4. As Tate (1941*d*) correctly pointed out, pm_2 is less

reduced in *ater (amboinensis)* than in *muricola* and its allies. This specimen complements others (BM(NH) 97.1.12.48–51, 7.1.1.504, 7.1.1.507) in the collections in London from Sulawesi: Shamel (1940) and Tate (1941*d*) recorded (as *amboinensis*) specimens from several Sulawesian localities to which Tate adds Vagian and Peleng Islands, and Papua New Guinea.

Measurements of BM(NH) 82.124, with those of other Sulawesian specimens in parentheses: length of forearm 36·5 ((6) 36·1–38·4); greatest length of skull 13·9 (14·2, 14·4); condylobasal length 13·3, (13·5, 13·7); condylocanine length 12·6 (12·8, 13·1); least interorbital width 3·5 (3·4, 3·5); zygomatic width 8·7 (—); width of braincase 6·4 (6·9); mastoid width 7·0 (7·6); c^1–c^1 (alveoli) 3·6 ((6) 3·8–4·0); m^3–m^3 5·6 ((5) 5·9–6·2); i^2–m^3 6·5 ((6) 6·6–6·8); c–m^3 5·4 ((6) 5·6–5·7); length complete mandible from condyles 10·4 ((3) 10·4–10·7); length right ramus from condyle 10·7 ((6) 20·7–10·9); c–m_3 5·8 ((6) 5·9–6·1.

Specimens from Siberut Island in the Mentawei Islands whence *M. ater* has not before been recorded agree in structure and size with *M. ater* from Sulawesi and the Molucca Islands, except that pm^3_3 are a little less reduced and less sharply intruded from the toothrows. Measurements of Siberut specimens: length of forearm (4) 34·8–36·2; greatest length of skull 14·1, 14·3; condylobasal length 13·5, 13·6; condylocanine length 12·9, 12·9; least interorbital width 3·5, 3·6; zygomatic width 9·3, 9·2; width of braincase 6·6, 6·5; mastoid width 7·5, 7·5; c^1–c^1 (alveoli) 3·9, 3·9; m^3–m^3 6·0, 6·2; i^2–m^3 6·6, 6·6; c–m^3 5·6, 5·6; length complete mandible from condyles 10·4, 10·5; length right ramus from condyle 10·9, 10·9; c–m_3 6·0, 5·9.

Discussion. Thomas (1915*a*) considered *M. ater* to be a larger ally of *M. muricola* from Sulawesi and the Moluccan Islands of Amboina, Buru and Ceram. Tate (1941*d*) retained *ater* in a distinct section of the subgenus *Selysius* (p. 545) although he also indicated (p. 564) that *ater,* as *amboinensis* with which Tate thought it possibly synonymous, might be a subspecies of *M. mystacinus* (=*M. muricola* in the present sense). Laurie & Hill (1954) listed *ater* as a subspecies of *M. mystacinus* (=*M. muricola*): however, specimens from the Ranu River show the two forms to occur sympatrically in Sulawesi. Moreover, a small specimen (BM(NH) 80.1.17.3) from Amboina (length of forearm 34·3, condylobasal length 12·9, condylocanine length 12·3, c–m^3 5·2) with small pm_2 and pm^3_3 slightly intruded does not represent *ambionensis* of Peters (length of forearm 37·5) but instead is referable to *M. muricola.* Although the collections in London contain no example of *ater (amboinensis)* from Amboina, specimens from Buru (BM(NH) 10.3.3.28–30, 23.1.1.14) and Ceram (BM(NH) 10.3.4.32–43, 23.1.2.15) are large (length of forearm (16) 36·8–39·2, condylobasal length (11) 13·7–14·1, condylocanine length (11) 13·0–13·5, c–m^3 (11) 5·6–5·9) and represent this species.

Hill (1962) and Medway (1965, 1977) regarded *ater* and *muricola* as conspecific, treating both as subspecies of *M. mystacinus* (=*M. muricola* in the present sense). The former of these authors provisionally associated *nugax* Allen & Coolidge, 1940 from northern Borneo and Culion Island in the Philippines (Sanborn, 1952) with *M. mystacinus* (=*M. muricola*) as a possible subspecies, while the latter considered it to be the subspecies of *M. mystacinus* (=*M. muricola*) in the highlands of northwestern Borneo, with *M. m. muricola* in the lowlands. However, on description and size it appears to represent *M. ater* and it is possible that the two may be conspecific as Tate (1941*d*) suggested, but the length of the toothrow of *nugax* given by Allen & Coolidge is rather large for *ater.* Tate (1941*d*) considered that these authors apparently had included the incisors rather than measuring from the canine as is customary and gave for MCZ 36075 (the holotype is MCZ 36076) in the Museum of Comparative Zoology, Harvard, a value for i^2–m^3 of 6·5 and for c–m^3 of 5·5, closely corresponding to *M. ater.*

Although similar in numerous points of size to *M. abbotti* Lyon, 1916 from North Pagi Island in the Mentawei Islands, specimens of *M. ater* from Siberut quite clearly show no relation to that form. Comparison with the account by Lyon indicates that the interorbital region and braincase of *abbotti* are considerably wider: moreover, Tate (1941*d*) considered *abbotti* to belong to the subgenus *Leuconoe* rather than to *Selysius,* although Lyon originally

described it as a subspecies of *M. muricola*. Tate in fact thought it belonged with *M. adversus* Horsfield, 1824, possibly as a synonym of *M. a. carimatae* Miller, 1906*d*. Diagnostic features not mentioned by Lyon can be gleaned from Shamel (1942) who noted that the wing membrane is attached to the ankle, thus differing from *M. ater* and from *M. horsfieldii* in which it is attached to the metatarsus, that pm^3 is much smaller than pm^2, its tip only slightly above the cingulum of the latter tooth, crowded completely from the toothrow with pm^2 and pm^4 almost in contact, while pm_3 is in the toothrow but crowded slightly to the inside. These features suggest alliance to *M. hasseltii* (Temminck, 1840) of which the nominate subspecies occurs in Java, Sumatra and Malaya, *M. h. continentis* Shamel, 1942 in Thailand and Burma and *M. h. macellus* (Temminck, 1840) in Borneo. Specimens apparently referable to *M. hasseltii* have also been obtained in Sri Lanka (Hill, 1976*a*).

The status of *Vespertilio australis* Dobson, 1878, allegedly from New South Wales, Australia has remained in doubt for many years. However, McKean (1970) has reproduced a detailed letter from Dr A. M. Husson describing its holotype, housed in the Rijksmuseum van Natuurlijke Historie, Leiden. The description, especially of the dentition, and the measurements that Dr Husson has provided agree closely with *M. ater*. Measurements given for the holotype of *australis*, with comparable values for *ater* from Sulawesi and the Moluccas in parentheses: length of forearm (ex Dobson, who gives 1′ 55′′) 39·5 ((23) 36·1–39·2); interorbital width 3·9 ((14) 3·3–3·5); c^1–c^1 3·7 ((18) 3·6–4·3); i^2–m^3 6·9 ((18) 6·5–7·1); c–m^3 5·8 ((18) 5·4–5·9); i_1–m_3 7·0 ((15) 6·9–7·5), c–m_3 6·3 ((18) 5·8–6·3.

Dr Husson rejects any relationship between *australis* and *M. adversus* but suggests instead that on dental features *australis* might be allied to *M. muricola*: to this McKean added that Laurie & Hill (1954) considered this a subspecies of *M. mystacinus* with the further subspecies *M. mystacinus ater* extending to Papua. The available evidence suggests strongly that *australis* is at least conspecific with *M. ater* but the origins of the holotype and only known specimen are obscure. Although it is on a mount marked 'Sydney N. Hollande' it may have been mislabelled, collected elsewhere, or may be a ship-assisted vagrant as Allison (1980) suggested.

Myotis horsfieldii horsfieldii (Temminck, 1840)

Vespertilio horsfieldii Temminck, 1840 : 226. Java.
Leuconoe lepidus Thomas, 1915*d* : 171. Baram, Sarawak, Borneo.

SPECIMENS EXAMINED. C Sulawesi: ♂, 5 ♀♀ BM(NH) 82.125–130 Taronggo, 1° 44′ S, 121° 40′ E (in alcohol, skulls extracted; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. Specimens from Sulawesi are cranially a little larger in some respects than those from Thailand (*M. h. deignani* Shamel, 1942) or Malaya, Borneo and Java (*M. h. horsfieldii*; the Bornean form *lepidus* was considered only weakly if at all separable by Hill (1974) and Medway (1977) has since synonymised it with the nominate subspecies), but the differences are very slight. Measurements appear in Table 5.

DISCUSSION. *Myotis horsfieldii* was first recorded as such from Sulawesi by Hill (1974) who reported a specimen (BM(NH) 73.1804) from Wawondula in the southern part of the island. Subsequently Jones & Maa (1976) reported an individual from Makassar (5° 07′ S, 119° 24′ E) as *M. horsfieldii* with the comment that Jentink (1883) had listed this species from northern but not southern Sulawesi and that Laurie & Hill (1954) had listed it from Peleng Island. However, neither Jentink nor Laurie & Hill mention *M. horsfieldii* but instead report *M. adversus* (the record in Laurie & Hill was drawn from Tate (1941*d*) who also reported *adversus* from Menado in northern Sulawesi) so that the exact identity of the specimen in the United States National Museum of Natural History reported by Jones & Maa must remain uncertain.

Table 5 Measurements of *Myotis horsfieldii* (numbers of specimens examined in parentheses).

	M. h. deignani Thailand	*M. h. horsfieldii* Malaya	*M. h. horsfieldii* Java	*M. h. horsfieldii* Borneo	*M. h. horsfieldii* Sulawesi	*M. h.* (?) *peshwa* India	*M. h.* (?) *dryas* S Andaman I
Length of forearm	36·3, 35·4	(5) 36·4–38·7	(29) 35·2–40·0	(9) 36·3–38·2	(7) 37·1–38·2	(8) 36·3–40·1	37·4, 35·3
Greatest length of skull	15·1, 15·3	(4) 15·2–15·9	(18) 14·6–16·0	(3) 15·7–15·8	(7) 15·1–15·8	(8) 15·4–16·1	15·2, —
Condylobasal length	13·9, 14·1	(4) 13·7–14·3	(18) 13·2–14·7	(3) 14·3–14·7	(7) 14·2–14·8	(8) 14·3–14·7	14·7, —
Condylocanine length	13·5, 13·6	(4) 13·1–13·6	(18) 13·0–13·9	(3) 13·5–13·8	(7) 13·5–14·3	(8) 13·6–14·1	13·5, —
Least interorbital width	3·5, 3·5	(4) 3·4–3·6	(18) 3·2–3·7	(3) 3·5–3·6	(7) 3·5–3·8	(8) 3·5–3·9	3·7, —
Zygomatic width	—, —	9·3, 9·4	9·4, 9·5	9·0	(7) 9·3–9·9	(3) 9·7–9·8	9·4, —
Width of braincase	7·1, 7·3	(4) 6·9–7·3	(18) 6·9–7·3	(3) 7·1–7·3	(7) 7·3–7·8	(8) 7·3–7·5	7·2, —
Mastoid width	7·7, 7·7	(4) 7·5–7·9	(17) 7·5–8·0	(3) 7·5–7·9	(7) 7·7–8·0	(8) 7·9–8·2	7·8, —
c^1–c^1 (alveoli)	4·2, 4·2	(3) 4·2–4·3	(18) 3·9–4·3	(3) 4·2–4·3	(7) 4·2–4·4	(8) 4·0–4·3	4·2, —
m^3–m^3	6·0, 5·8	(4) 5·7–6·1	(18) 5·6–6·1	5·9, 6·1	(7) 6·0–6·2	(8) 5·8–6·1	5·9, —
c–m^3	5·7, 5·7	(4) 5·6–5·9	(18) 5·4–5·8	(3) 5·8–6·0	(7) 5·7–6·0	(8) 5·5–5·8	5·7, 5·6
Length complete mandible from condyles	10·5, 10·5	10·9, 10·8	(16) 10·4–11·0	10·8, 11·0	(7) 10·6–11·2	(8) 10·6–11·0	10·7, —
Length right ramus from condyle	10·9, 10·9	(4) 10·9–11·3	(18) 10·8–11·5	11·2	(7) 10·9–11·5	(8) 11·1–11·5	11·1, —
c–m_3	6·1, 6·1	(4) 6·0–6·3	(18) 6·0–6·4	(3) 6·2–6·4	(7) 6·2–6·5	(8) 6·1–6·3	6·0, —

Table 6 Measurements of *Myotis hasseltii* (number of specimens examined in parentheses).

	M. h. continentis Burma	*M. h. continentis* Thailand, Cambodia	*M. h. hasseltii* Malay Peninsula, Java	*M. h. macellus* Borneo	*M. h.* (?) Sri Lanka
Length of forearm	38·5	(12) 35·7–39·2	(8) 38·8–41·2	36·9	(5) 37·4–40·3
Greatest length of skull	16·2	(8) 15·3–16·0	(6) 15·6–16·3	15·4	(4) 16·0–16·6
Condylobasal length	15·1	(8) 14·0–14·6	(5) 14·2–15·0	14·1	(4) 14·8–15·5
Condylocanine length	14·3	(8) 13·3–13·8	(5) 13·5–14·3	13·4	(4) 14·2–14·7
Least interorbital width	4·2	(10) 3·9–4·2	(7) 3·7–4·2	3·9	(4) 4·0–4·2
Zygomatic width	—	(5) 9·9–10·2	10·3	—	—
Width of braincase	8·1	(9) 7·5–7·9	(7) 7·6–8·1	7·8	(4) 8·1–8·6
Mastoid width	8·5	(8) 8·0–8·6	(5) 8·0–8·7	8·0	(4) 8·6–8·7
c^1–c^1 (alveoli)	4·6	(8) 4·2–4·5	(6) 4·1–4·6	4·3	(4) 4·4–4·6
m^3–m^3	6·5	(9) 5·8–6·2	(7) 6·1–6·7	6·2	(4) 6·5–6·7
c–m^3	6·1	(9) 5·3–5·7	(7) 5·7–6·1	5·6	(4) 5·9–6·0
Length complete mandible from condyles	—	(8) 10·5–11·4	(4) 10·8–11·3	10·8	(4) 11·2–11·6
Length right ramus from condyle	11·8	(5) 10·3–11·1	(7) 11·1–11·8	11·0	(4) 11·6–12·0
c–m_3	6·4	(9) 5·9–6·2	(7) 6·1–6·5	6·1	(4) 6·3–6·5

Hill (1976*a*) thought *peshwa* Thomas, 1915*a* from India and *dryas* Andersen, 1907*b* closely related to *M. horsfieldii* of which both are here considered provisional subspecies. It is also possible that *M. jeannei* Taylor, 1934 from Zamboanga Island, Philippine Islands may represent *M. horsfieldii*: there is reasonable agreement in size and the wing membrane in *jeannei* is attached to the foot about halfway between the heel and the base of the toe, a characteristic feature of *M. horsfieldii* when compared with *M. adversus* or *M. hasseltii* in which it attached at the end of the tibia or at the ankle.

Myotis hasseltii continentis Shamel, 1942

Myotis adversus continentis Shamel, 1942 : 323. Bangkok, Thailand.

SPECIMEN EXAMINED. Burma: ♂ BM(NH) 78.154 British Embassy Residence compound, Rangoon (in alcohol, skull extracted; coll. D. W. & G. Walton).

REMARKS. This specimen is the first of *M. hasseltii* to be reported from Burma, although the species is known to occur farther north in Thailand, at Chiangmai (BM(NH) 9.10.11.6–9). It agrees closely with examples of *M. h. continentis* from Thailand but is slightly larger in some respects (Table 6), approaching *M. h. hasseltii* from the Malay Peninsula and Java, or the specimens from Sri Lanka discussed by Hill (1976*a*). The second upper premolar (pm^3) of the Burmese specimen is very small, totally intruded from the row, with pm^2 and pm^4 in contact, while pm_3 is small, slightly intruded but nevertheless separates pm_2 and pm_4.

No examples of *M. hasseltii* were obtained by 'Operation Drake' in Sulawesi, whence its reported occurrence apparently rests on specimens recorded by Jentink (1887, 1888) from Gorontalo in the northern part of the island.

Myotis adversus moluccarum (Thomas, 1915)

Leuconoe moluccarum Thomas, 1915*d* : 170. Ara, Kei Islands.
Anamygdon solomonis Troughton, 1929 : 89. Rovianna I, New Georgia group, Solomon Is.

SPECIMENS EXAMINED. C Sulawesi: 2 ♂♂, ♀ BM(NH) 82.131–133 R Ranu, 1° 51′ S, 121° 30′ E (in alcohol, skulls extracted; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. Tate (1941*d*) referred specimens of *M. adversus* from Sulawesi, Peleng Island and West Irian to *M. a. moluccarum,* with which these agree closely. They are rather smaller than *M. a. adversus* (Horsfield, 1824) from Java: the Bornean and Sumatran subspecies *M. a. carimatae* Miller, 1906*d* is very similar to *moluccarum* but only limited material is available for comparison.

Myotis adversus orientis subsp. nov.

HOLOTYPE. New Hebrides: ♀ BM(NH) 73.1412 Eastern cave at cliff base behind Aouta Plantation, Aore I. Collected 24 August 1971 by the Earl of Cranbrook, presented by the Royal Society Expedition to the New Hebrides, 1971. Original number 104–02. Skin and skull.

OTHER MATERIAL. New Hebrides: 3 ♂♂, 7 ♀♀ BM(NH) 73.1404–1411, 73.1413 (in alcohol, skulls extracted), 73.1414 (skin, skull). All from type locality (obtained Earl of Cranbrook, Royal Society Expedition to the New Hebrides, 1971).

DIAGNOSIS. A member of the subgenus *Leuconoe,* generally slightly larger (Table 7) in most respects than the geographically adjacent *M. a. moluccarum* from the Solomon Islands, New

Table 7 Measurements of *Myotis adversus* (number of specimens examined in parentheses).

	M. a. adversus Java	*M. a. carimatae* Borneo	*M. a. moluccarum* Sulawesi–Solomon Is	*M. a. macropus* Australia	*M. a. orientis* New Hebrides	*M. a. orientis* Holotype ♀ BM(NH) 73.1412
Length of forearm	(25) 41·7–44·0	39·8, 40·2	(27) 37·5–42·1	(8) 36·6–40·4	(11) 41·1–43·9	43·2
Greatest length of skull	(6) 17·0–17·4	16·3, 16·5	(8) 15·4–16·3	—	(10) 15·6–16·3	15·9
Condylobasal length	(6) 15·2–15·8	14·9, 15·2	(9) 14·4–15·1	—	(10) 14·8–15·5	15·0
Condylocanine length	(6) 14·4–14·9	14·0, 14·1	(9) 13·4–14·3	—	(10) 14·1–14·7	14·3
Least interorbital width	(6) 4·1–4·3	4·0, 4·1	(9) 3·8–4·2	3·9, 4·0	(10) 4·3–4·6	4·4
Zygomatic width	(3) 10·4–10·5	—, 10·4	(3) 9·9–10·2	—	(5) 9·9–10·1	10·1
Width of braincase	(6) 7·9–8·0	7·2, 7·2	(9) 7·4–8·0	—	(10) 7·8–8·3	8·0
Mastoid width	(6) 8·5–8·7	8·5, 8·6	(9) 7·9–8·5	—	(10) 8·0–8·3	8·3
c^1–c^1 (alveoli)	(6) 4·5–4·8	4·5, 4·5	(9) 4·3–4·6	(3) 4·4–4·5	(10) 4·5–4·8	4·6
m^3–m^3	(6) 6·7–7·0	6·4, 6·5	(9) 6·2–6·8	(3) 6·3–6·5	(10) 6·7–7·0	6·9
c–m^3	(6) 6·2–6·4	5·9, 6·0	(9) 5·7–6·2	(3) 5·8–6·1	(11) 5·9–6·1	6·0
Length of complete mandible from condyles	(5) 11·6–11·9	11·3, 11·5	(6) 11·1–11·3	(3) 10·9–11·3	(6) 11·2–11·6	11·4
Length of right ramus	(6) 12·1–12·5	11·6, 11·8	(9) 11·0–11·8	(3) 11·1–11·6	(10) 11·7–12·0	11·7
c–m_3	(6) 6·6–6·9	6·3, 6·3	(9) 6·1–6·5	(3) 6·2–6·5	(11) 6·4–6·5	6·4

Guinea, the Moluccas and Sulawesi, approaching *M. a. adversus* from Java in size; differing from these, from *M. a. carimatae* from Borneo and from *M. a. macropus* (Gould, 1855) from Australia in a slightly greater degree of frontal elevation of the rostrum, the frontal profile less concave, in wider, more substantial interorbital region, and in greater inflation of the braincase, which is more globose, especially anteriorly, slightly higher, and more elevated posteriorly.

DESCRIPTION. Externally very like *M. a. adversus* or *M. a. moluccarum* with relatively large, rounded ears reaching almost to tip of muzzle when laid forward; tragus in length a little less than half length of ear, slender, pointed, its anterior margin straight, its posterior margin gently convex; wing inserted at ankle. Pelage dense and woolly, dorsally blackish brown, the hairs dark at the base and for most of their length, tipped lightly with greyish or buffy white, the tipping forming no more than a slight overlay, the ventral surface greyish white, the hairs blackish at the base, heavily and densely tipped with grey white, posteriorly with little or no black at the base. Dorsal pelage darker and blacker than brownish examples of *moluccarum* from Sulawesi and the Molucca Islands but these are old specimens that have been preserved for many years: a similarly old specimen from Choiseul Island in the Solomon Islands approaches examples from the New Hebrides in dorsal colour.

Skull strongly constructed, with broad, high rostrum, its upper surface flattened posteriorly with a broad, shallow median longitudinal depression; frontal profile only slightly depressed; interorbital region broad, relatively massive, least interorbital width 28–30% of condylobasal length, 54–57% of width of braincase; 26–28% of condylobasal length, 49–54% of width of braincase in *adversus, carimatae* and *moluccarum*; braincase inflated, globose, anteriorly relatively full, elevated posteriorly; palate short and wide, with strong post-palatal spine, supported by thin lateral laminae; second upper premolar (pm^3) small, its crown area about one third crown area of anterior tooth (pm^2), almost in row, slightly intruded, or intruded from row to lie in a recess between pm^2 and last upper premolar (pm^4); second lower premolar (pm_3) in crown area about one third crown area of anterior tooth (pm_2), almost in row but compressed between pm_2 and last lower premolar (pm_4), or sometimes slightly intruded.

Measurements of *M. a. orientis* appear in Table 7.

ETYMOLOGY. An eastern representative of *M. adversus*.

DISCUSSION. Excluding very large species such as *M. macrotarsus* (Waterhouse, 1845) from the Philippine Islands and northern Borneo and *M. stalkeri* Thomas, 1910*a* from the Kei Islands leaves in Indo-Australia a group of large-footed bats of the subgenus *Leuconoe* with forearms ranging in length from 36–44 and with pm^2 and pm_3 variably reduced and variably situated in the toothrows. Their current classification has been established by views and opinions scattered through several publications. These include Tate (1941*d*), Medway (1965, 1977), Findlay (1972), Hill & Thonglongya (1972) and Hill, (1972, 1974, 1976*a*). The arrangement adopted here has been developed from these and may be summarized:

1.	Wing inserted on metatarsus	*M. horsfieldii*
	Wing inserted at end of tibia or at ankle	2
2.	Fur short, velvety; post-palatal extension short, its median spicule lacking thin bony supporting laminae; pm^3 minute, intruded, pm^2 and pm^4 in contact or nearly so, pm_3 small, only partially in row or completely intruded	*M. hasseltii*
	Fur, dense, woolly; post-palatal extension long, its median spicule supported by thin bony laminae; pm^3 not greatly reduced, pm^3 not usually much intruded, pm_3 usually in row or only slightly intruded	*M. adversus*

Myotis horsfieldii deignani Shamel, 1942	Thailand, Hainan I, Hong Kong (Findley, 1972).

Myotis horsfieldii horsfieldii (Temminck, 1840) (incl. *lepidus* Thomas, 1915*d*)	Malaya, Borneo, Java, Bali, Sulawesi.
Myotis horsfieldii (?) *peshwa* Thomas, 1915*a* (see Hill, 1976*a*)	India.
Myotis horsfieldii (?) *dryas* Andersen, 1907*b* (see Hill, 1976*a*)	South Andaman I.
Myotis horsfieldii (?) *jeannei* Taylor, 1934	Zamboanga I, Philippine Is.
Myotis hasseltii continentis Shamel, 1942	Burma, Thailand, Kampuchea, (?) Sri Lanka.
Myotis hasseltii hasseltii Temminck, 1840	Malaya, Rhio Archipelago, Sumatra, Java.
Myotis hasseltii macellus Temminck, 1840	Borneo.
Myotis hasseltii (?) *abbotti* Lyon, 1916	North Pagi I, Mentawei Is, off W Sumatra.
Myotis adversus adversus Horsfield, 1824	Java, (?) Malaya.
Myotis adversus carimatae Miller, 1906*d*	Borneo, Karimata I.
Myotis adversus moluccarum Thomas, 1915*d*	Sulawesi, Molucca Is, New Guinea, Solomon Is.
Myotis adversus orientis Hill, 1983	New Hebrides.
Myotis adversus macropus Gould, 1855	Australia.

Pipistrellus javanicus (Gray, 1838)

Scotophilus javanicus Gray, 1838 : 498 (renaming of *Vespertilion javanais* F. Cuvier, 1832). Java.

Specimens examined. C Sulawesi: ♀ BM(NH) 82.134 R Ranu, 1° 51′ S, 121° 30′ E (in alcohol, skull extracted; coll. B. H. Gaskell, 'Operation Drake').

Remarks. This specimen from Sulawesi agrees in most respects with examples of *P. javanicus* from Java and from the island of Madura. It differs from these only in the slightly greater concavity of its rostral profile, in having the frontal part of the braincase a little more inflated and in a slightly higher posterior upper canine cusp. Measurements: length of forearm 32·1; greatest length of skull 13·6; condylobasal length 12·7; condylocanine length 12·3; least interorbital width 3·5; zygomatic width 8·6; width of braincase 6·7; mastoid width 7·3; c^1–c^1 (alveoli) 4·3; m^3–m^3 6·2; c–m^3 4·9; length complete mandible from condyles 9·4; length right ramus from condyle 9·8; c–m_3 5·2.

Discussion. Several species of *Pipistrellus* have been reported or described from Sulawesi. These include *P. javanicus* (Gray, 1838) by Dobson (1878) (as *abramus,* a subspecies of *P. javanicus* according to Laurie & Hill, 1954), Meyer (1899) (as *abramus*) and Shamel (1940) (also as *abramus*); *P. imbricatus* (Horsfield, 1824) by Tate (1942*b*); possibly *P. papuanus* (Peters & Doria, 1881) by Laurie & Hill (1954); *P. petersi* (Meyer, 1899), described from northern Sulawesi and reported again by Shamel (1940) and Tate (1942*b*), and *P. minahassae* (Meyer, 1899), also described from northern Sulawesi and again reported provisionally by Tate (1942*b*). Of specimens recorded as *abramus* by Dobson (1878), one (BM(NH) 72.4.11.4) from northern Sulawesi is neither *javanicus* nor is it *papuanus,* as Laurie & Hill (1954) thought it might be, so far as can be judged from the damaged skull. A second specimen, a skin only, cannot be found. The cranial features of the holotypes of *petersi* and *minahassae* have never been recorded, but Tate (1942*b*) provides information and measurements drawn from the referred specimens that he reported.

There are few records of specimens referable to *P. javanicus* from the area east of Java and Sulawesi. I have examined specimens supposedly of this species in the collection of the Zoologisches Museum (Museum für Naturkunde), Berlin from Bali (ZMB 90465, 90468–90471) and from Sumba Island (ZMB 92152–92157), the latter those reported as *P. tralatitius* (=*P. javanicus*) by Pohle (1950). None in fact represent *P. javanicus* but instead are examples of *Myotis muricola,* recorded from Sumba by Forcart (1952). Schwarz (1914) reported *P. tralatitius* from Timor Island, but these records from Lelogama and Bonleo may refer to *P. tenuis* as Goodwin (1979) suggested. Other specimens from Timor recorded as *P. tralatitius* by Pohle (1950) prove (vide infra) to be examples of *P. tenuis.* Dobson (1878) recorded two specimens of *Pipistrellus abramus* from 'Australia', having earlier (1876) suggested that the species extended to that country. These are BM(NH) 47.7.21.12–13, in alcohol: their skulls have now been extracted. The two specimens agree closely with *P. javanicus* which evidently they represent: a further specimen, BM(NH) 80.1.17.4 from the Aru Islands may also represent this species but is rather smaller.

Pipistrellus tenuis papuanus (Peters & Doria, 1881)

Vesperugo papuanus Peters & Doria, 1881 : 696. Salawatti, West Irian, NW New Guinea.
Vesperugo papuanus orientalis Meyer, 1899 : 14. Bongu, Astrolabe Bay, Papua New Guinea.

Specimens examined. Papua New Guinea: ♂, ♀♀ BM(NH) 73.2046–2048 Kairiru I, near Wewak, East Sepik (in alcohol; coll. Aberdeen University Exploration Society Expedition to New Guinea, 1973); ♀♀ BM(NH) 80.644–645 Wau Gulf, Morobe, 7° 19′ S, 140° 44′ E; ♀♀ BM(NH) 80.646–651 Lae, Morobe, c. 6° 49′ S, 147° 03′ E; ♂. ♀♀ BM(NH) 82.148–152 Cave near Avi, Mt. Hagen (all in alcohol; coll. B. H. Gaskell, 'Operation Drake'); ♀ BM(NH) 82.157 Lake Murray Wildlife Station, Boboa, Western Province (in alcohol; coll. I. M. Redmond).

Remarks. These specimens with forearm lengths ranging from 29·3–31·6 are in good agreement with *P. t. papuanus* as represented in the collections of the British Museum (Natural History).

Discussion. Laurie & Hill (1954) recognised *papuanus* as a distinct species in New Guinea, together with *P. angulatus* of which they listed three subspecies, *P. a. angulatus* Peters, 1880 from the Bismarck Archipelago, *P. a. collinus* Thomas, 1920 from mainland New Guinea and *P. a. ponceleti* Troughton, 1936 from the Solomon Islands, in general following the leads provided by Tate (1942*b*). Lidicker & Ziegler (1968) adopted the classification offered by Laurie & Hill but tentatively raised *ponceleti* to specific rank, and added *P. imbricatus* (Horsfield, 1824) to the New Guinea list by referring specimens from Balim River, West Irian and Emirau Island in the Bismarck Archipelago to that species. More recently, Koopman (1973) has reviewed the Indo-Australian pipistrelles associated with *P. tenuis,* with particular reference to the forms known from New Guinea. His study led him to unite *papuanus, angulatus, collinus* and *ponceleti* (and also *nitidus* Tomes, 1858 from Borneo (referred to *P. tenuis* as a subspecies by Medway, 1965), *subulidens* Miller, 1900 from Sirhassen Island, *sewelanus* Oey, 1960 from Lombok Island and *murrayi* Andrews, 1900 from Christmas Island) into a single species, *P. tenuis* (Temminck, 1840). He mentioned but did not discuss the records of *P. imbricatus* by Lidicker & Ziegler.

Although the collections of the British Museum (Natural History) include a substantial number of specimens that can be referred to *P. t. papuanus,* there are few that can be confidently identified with *collinus, angulatus* or *ponceleti.* However, there is some evidence to confirm Koopman's (1973) division of Papuan examples into a small, relatively lowland form (*papuanus*) and a larger highland form (*collinus*), separated also by the dimensions of the palate, which is relatively short and narrow in the lowland form but longer and wider in the montane form. Additionally, montane specimens have a concave rostral profile in contrast to the flatter, less depressed profile usual in lowland examples. No montane specimens

are available from West Irian, but lowland examples from the western part of the island confirm the indication by Koopman (Figs. 1, 3) that here the lowland form has a longer skull nearer in size to that of the montane form, with a correspondingly slightly longer and slightly wider palate. However, Koopman examined only three variables and it is also clear from his diagrams (Figs. 1–3) that high montane (especially above 1800 m) specimens differ considerably from those from lower altitudes in the dimensions of the palate: those from altitudes of 1000–1800 m in Papua ally themselves in palatal size with the high montane examples (Fig. 2) but in West Irian (Fig. 3) with more truly lowland specimens. Similarly, in length of skull (Fig. 1) specimens from the intermediate zone in Papua are like those from higher altitudes but in West Irian are approached in size by lowland examples. The variation in eastern New Guinea and its associated islands has been analysed in greater detail by Koopman (1982). *Pipistrellus tenuis papuanus* also occurs on the Bismarck Archipelago whence Smith & Hood (1981) have recorded specimens that they refer to this form, together with other larger examples that apparently represent *angulatus,* the two perhaps being separated also by roosting preference. Moreover, specimens examined by Koopman (1973) from New Britain with forearms 28–30 in length may also represent *P. t. papuanus.*

It is unlikely that specimens from Emirau Island, Bismarck Archipelago and from the Balim River, West Irian represent *P. imbricatus* as Lidicker & Ziegler (1968) averred. According to these authors the specimen from Emirau (from their illustration, fig. 4) has a concave rostral profile and has an anterior upper premolar (pm^2) of cross-sectional area about equal to two thirds of the cross-sectional area of the outer upper incisor (i^3). However, in a series of *P. imbricatus* from Java in the British Museum (Natural History) the rostral profile is straight or nearly so, a point reinforced by Koopman (1973) who recorded that *imbricatus* has a flat, not concave forehead, and pm^2 is very small, sometimes minute, not more and usually less than one third the cross-sectional area of i^3. Tate (1942) identified the Balim River specimens (AMNH 109979–109980) as *'P. imbricatus collinus',* and Smith & Hood (1981) suggest that for the present the Emirau specimen seems best referred to *angulatus.*

Pohle (1950) recorded *P. tralatitius* (=*P. javanicus*) from Timor on the basis of specimens in the Zoologische Museum (Museum für Naturkunde), Berlin, collected by G. Stein in 1932. I have examined the skulls of these specimens (ZMB 92107–92111), all from Tjamplong and they prove not to represent *P. javanicus* but to be closely similar to if not identical with *P. tenuis papuanus.* Goodwin (1979) also reports *P. tenuis* from Timor, and gives measurements (taken by Dr K. F. Koopman) of further specimens from Tjamplong collected by Stein and now in the Museum Zoologicum Bogoriense, Bogor. Two specimens reported from Timor by Schwarz (1914) as *P. tralatitius* may also be *P. tenuis,* as Goodwin suggests. Koopman (1973) allocates Timorese specimens to *P. t. sewelanus,* along with those from Sulawesi.

Collett (1897) recorded a single specimen from Roebuck Bay, near Broome, northwestern Australia as *P. tenuis.* This specimen, collected by Dahl and now in the Oslo Museum, was sent to the British Museum (Natural History) in 1966 for examination. It proved to agree closely with *P. t. papuanus* but to be slightly larger cranially, with a narrower, blade-like post-palatal spine and slightly less prominent basioccipital pits, and to have a slightly less prominent posterior upper canine cusp. More recently, in 1976, two specimens (AMNH 216135–216136) from the collections of the American Museum of Natural History were examined for Dr Karl F. Koopman. These agree basically with *P. t. papuanus* but have the narial emargination a little more rounded and less acute posteriorly, the palate slightly more domed and less prominent posterior cusps on the upper canines. Although for the present I would refer these specimens to *P. t. papuanus* it seems probable that more material might well show the Australian population to be subspecifically separable.

The limited material in the British Museum (Natural History) supports the association of *papuanus* with *tenuis* as Koopman (1973) proposed, although of the latter only two so-called 'cotypes' (BM(NH) 7.1.1.407–408) are available for the study, Tate (1942*b*) having selected as lectotype a specimen in the Rijksmuseum van Natuurlijke Historie, Leiden. On the basis of

this sample I am inclined to agree that *tenuis* and *papuanus* are conspecific: both are characterised by small size, short premaxillae, the narial emargination quite sharply narrowed posteriorly, the anterior upper premolar (pm^2) moderate in size, situated in the internal angle between c^1 and the posterior upper premolar (pm^4), which almost touch or are in contact. Of the two forms, *P. t. tenuis* is apparently slightly the larger: it is similar in size to a small series of *murrayi* from Christmas Island which also clearly represents *P. tenuis* and may even be synonymous with the nominate subspecies. A specimen (AMNH 107827) in the American Museum of Natural History from Bratan, Bali examined in 1970 for Dr Karl F. Koopman also represents this complex. Then labelled *'Pipistrellus (coromandra) imbricatus* subsp' which very evidently it is not, it is apparently the example identified by Tate (1942*b*) as *P. tenuis*. It is similar to the 'cotypes' of *tenuis* or to *murrayi* but the skull is a trifle longer and wider and the toothrows slightly longer, in these respects approaching *papuanus*. Koopman (1973) refers specimens from Bali and Java to *P. t. nitidus*. The cranial measurements of specimens discussed appear in Table 8.

Pipistrellus vordermanni (Jentink, 1890)

Vesperugo vordermanni Jentink, 1890 : 152. Billiton I.

SPECIMEN EXAMINED. Borneo: ♀ BM(NH) 82.547 Samunsan Wildlife Sanctuary, Sarawak. (in alcohol, skull extracted; coll. N. A. MacKenzie).

REMARKS. This is the first of *P. vordermanni* to be recorded from Borneo; no direct comparison has been possible but the specimen agrees closely with the original account by Jentink. Among Bornean pipistrelles the species may be readily recognised by its large ears, slightly hatchet-shaped tragus with anteriorly directed point, whitish wings, short skull, full, rounded braincase and short rostrum, small supraorbital tubercles, deep zygomata with distinct postorbital process, deep basial pits, minute anterior upper premolar (pm^2) which is completely intruded into a recess between the canine and the posterior upper premolar (pm^4), the two latter teeth in contact, and much reduced anterior lower premolar (pm_2).

DISCUSSION. Chasen (1940) synonymised *vordermanni* and *curtatus* Miller, 1911 from Engano Island, off the west coast of Sumatra, with the Sumatran *macrotis* (Temminck, 1840) which he considered a subspecies of *P. imbricatus* (Horsfield, 1824) from Java. However, all differ sharply from *imbricatus* in a decidedly shorter rostrum and consequently shorter palate, a point emphasised by Miller in his description of *curtatus*. Tate (1942*b*) treated *macrotis, vordermanni* and *curtatus* as distinct species, associating them with *P. cadornae* Thomas, 1916 from Burma in the *savii* group of *Pipistrellus*. Hill (1962) followed Tate in considering *macrotis* and *vordermanni* distinct species but removed them, with *cadornae,* from any close relationship with *P. savii* (Bonaparte, 1837). As Tate (1942*b*) pointed out, the four forms clearly constitute an assemblage characterised by the cranial and dental characters noted above. The larger size of *cadornae* sets it rather apart from *macrotis, vordermanni* and *curtatus* which may well prove to be conspecific.

Measurements of the Bornean example of *vordermanni* with (in parentheses) those of an example (BM(NH) 23.1.2.12) of *macrotis* from Sebang, Sumatra: length of forearm 30·5 (31·5); length of ear 15·1 (14·7); greatest length of skull 11·4 (12·2); condylobasal length 11·1 (11·8); condylocanine length 10·8 (11·5); width across supraorbital tubercles 4·6 (4·7); zygomatic width 8·2 (8·4); least interorbital width 3·5 (3·5); width of braincase 6·4 (6·5); mastoid width 7·0 (7·3); c^1–c^1 (alveoli) 4·0 (3·9); m^3–m^3 5·1 (5·3); c–m^3 3·8 (4·0); length of complete mandible from condyles — (7·8); length of right ramus from condyle — (8·3); c–m^3 4·2 (4·4). Measurements of type material of *macrotis, vordermanni* and *cadornae* are given by Tate (1942*b*) and of the holotype and additional specimens of *cadornae* by Hill (1962).

Table 8 Selected cranial measurements of *Pipistrellus tenuis* (number of specimens examined in parentheses).

	P. t. tenuis Sumatra 'Cotypes'	Bali	*P. t. murrayi* Christmas I	Timor	*P. t. papuanus* New Guinea	Australia
Condylocanine length	—	11·3	(6) 10·8–11·0	(3) 10·8–11·0	(14) 10·2–11·6	(3) 10·3–11·0
Width of braincase	—	6·2	(6) 5·9–6·3	(5) 5·8–6·1	(13) 6·0–6·6	(3) 6·0–6·3
Mastoid width	—	6·8	(6) 6·6–6·8	6·7, 6·8	(14) 6·6–7·3	(3) 6·9–7·1
c^1–c^1 (alveoli)	—, 3·5	3·7	(6) 3·4–3·9	(5) 3·8–4·1	(15) 3·6–4·2	(3) 3·5–4·2
m^3–m^3	—, 4·8	5·2	(6) 4·8–5·1	(5) 5·2–5·6	(15) 5·0–5·7	(3) 4·8–5·6
c–m^3	3·5, 3·7	4·4	(6) 4·0–4·2	(5) 4·1–4·4	(15) 3·8–4·4	(3) 3·8–4·3

Pipistrellus societatis Hill, 1972

Pipistrellus societatis Hill, 1972 : 34. Base Camp, Gunong Benom, Pahang, Malaya, 800 ft, 3° 51′ N, 102° 11′ E.

SPECIMEN EXAMINED. Malaya: ♀ BM(NH) 81.1802 Sungai Tekam Forest Reserve, Pahang (in alcohol, skull extracted; coll. A. O. Johns).

REMARKS. This is the first example of *P. societatis* to be reported since its description, the holotype (BM(NH) 67.1605) being then the only known example. This newly obtained specimen is in good general agreement with the holotype but is slightly larger in some respects and has, however, a small, low sagittal crest that is absent from the original example. The narial emargination is very slightly narrowed posteriorly and the last upper molar (m^3) is slightly less reduced than in the holotype, with a more evident but small metacone and short third commissure, although as in the holotype the tooth is flattened antero-posteriorly and more platelet-like when compared with the closely related species *P. circumdatus*. As in the holotype the hypoconid and entoconid of the last lower molar (m_3) are also slightly reduced in comparison with those of the related species.

Measurements: length of forearm 39·4; greatest length of skull 15·0; condylobasal length 14·3; condylocanine length 14·1; length orbit–gnathion 3·9; palatal length, excluding post-palatal spine 6·7; length palatal bridge, excluding post-palatal spine 5·1; width across ante-orbital foramina 3·2; lachrymal width 6·8; width across supraorbital tubercles 6·0; zygomatic width 10·5; least interorbital width 4·3; width of braincase 7·5; mastoid width 8·4; c^1–c^1 (alveoli) 4·8; m^3–m^3 7·0; c–m^3 5·5; length of complete mandible from condyles 10·6; length of right ramus from condyle 11·0; c–m_3 5·9.

DISCUSSION. Hill (1972, 1974) reported an example of the closely related *P. circumdatus* from Fraser's Hill, Pahang. Certain features of this species and of *P. societatis* tend towards the Australian genus *Chalinolobus* and more distantly towards the nominal genus *Glauconycteris* from Africa. Both species show an approach to *Chalinolobus* in the development of a slightly pendent lobule at the base of the outer margin of the ear, inserted a little behind and below the angle of the mouth, in an elevated, rounded braincase and the inflation of the supraorbital region, a shortening of the rostrum and a narrowing of the anterior palatal emargination, the arrangement of the upper incisors into a straight line and the reduction of the anterior upper premolar (pm^2) almost to the point of obsolescence.

Philetor brachypterus rohui Thomas, 1902

Philetor rohui Thomas, 1902 : 220. Albert Edward Range, eastern Papua New Guinea, 6000 ft.

SPECIMENS EXAMINED. Papua New Guinea: ♂, ♀♀BM(NH) 80.652–656, ♂ BM(NH) 80.694 Buso, Morobe, 6° 41′ S, 147° 13′ E (in alcohol; coll. B. H. Gaskell; 'Operation Drake').

Philetor brachypterus verecundus (Chasen, 1940)

Eptesicus verecundus Chasen, 1940 : 53. Mt. Kledang, Perak, Malaya, 2646 ft.

SPECIMEN EXAMINED. Borneo: ♂ BM(NH) 78.1542 Gunung Mulu, Sarawak, 2600 ft (in alcohol; coll. D. R. Wells, Royal Geographical Society Expedition to Gunung Mulu, 1977–78).

REMARKS. This species has been recorded previously from two Bornean localities, Pangkalan Lobang, at Niah, Sarawak, and Poring National Park, at Ranau in Sabah (Lim, Chai & Muul, 1974; Medway, 1977). Two of these specimens were examined at the British Museum (Natural History) in 1975 and found to approach *P. b. rohui* from New Guinea in the width

of the narial emargination rather than *P. b. verecundus* from Malaya. However, a specimen (BM(NH) 73.597) from Ulu Gombok, Selangor, Malaya has a similarly narrower emargination and as Medway (1977) suggests, this feature seems of little value in establishing subspecies. Among specimens in the British Museum (Natural History) the forearm of those of *P. b. verecundus* is a little longer on the whole than in *P. b. rohui*: in twenty Malayan examples the length of the forearm ranges from 33·0–37·6, in thirty one from New Guinea from 31·3–35·6. In size the Bornean example (length of forearm 35·4) agrees with those from Malaya (Lim, Chai & Muul, 1974, give forearm lengths of 33–36 for eight further specimens from Borneo). However, Kock (1981) records specimens from New Britain in the Bismarck Archipelago and from New Guinea that are similar in forearm length to those from Malaya. For the present Bornean specimens are referred to *P. b. verecundus,* but subspecific validities are very provisional in *P. brachypterus,* the features of its Sumatran representative, (nominally *P. b. brachypterus*) remaining largely unknown (Hill, 1966*b* 1971*b*). The collections in London include an unreported series (BM(NH) 74.415–434) of *P. b. verecundus* from Paloh Forest Reserve, Paloh, Kluang, Johore, Malaya.

Hesperoptenus (Milithronycteris) gaskelli sp. nov.

HOLOTYPE. Central Sulawesi: ♀ (yg. ad.) BM(NH) 82.135. River Ranu, 1° 51′ S, 121° 30′ E. Collected 19 April 1980 by B. H. Gaskell, 'Operation Drake'. In alcohol, skull extracted.

DIAGNOSIS. Characteristically a member of the subgenus *Milithronycteris* similar in many respects to *H. tickelli* or *H. tomesi,* differing principally from *H. blanfordi* in much larger size, naked internarial region, the dorsal surface of the forearm lacking any dense covering of hair, the absence of a fleshy pad at the base of the thumb, inflated braincase, narrow postorbital region and relatively less reduced outer upper incisors (i^{3-3}) and last upper molars ($p\frac{3}{3}$). Differing from *H. tickelli* and *H. tomesi* in smaller size and smaller teeth (a comparison of the young adult holotype with two examples of *H. tickelli* of similar or even slightly younger age shows the dentition of the latter to be substantially larger) the canine and postcanine teeth little more than one half the basal area of their counterparts in *H. tickelli,* and for the most part rather less than one half the basal area of those of *H. tomesi,* inner upper incisors (i^{2-2}) similarly smaller, the lower incisors about one third smaller than those of *H. tickelli* and about half the size of those of *H. tomesi.* Differing further from *H. tickelli* in its rich, dark, blackish rather than yellowish brown or straw brown overall coloration, in much shortened second phalanx of the third digit, in the development of small supraorbital tubercles and slightly more vertical orbital margin, deeper, more sharply sculpted basioccipital pits, a narrower cingulum on the outer upper incisor (i^3), more flattened last upper molar (m^3) and a slightly greater degree of reduction of the last lower molar (m_3); from *H. tomesi* in a lesser degree of intrusion of the outer upper incisor (i^3), in a lack of thickening of the first and second lower incisors (i_{1-2}) and a less thickened outer lower incisor (i_3), its cusp pattern remaining evident.

DESCRIPTION. Muzzle low, wide, laterally swollen, sparsely pilose, with medianly a very shallow longitudinal groove behind the nostrils; narial openings nearly circular, moderately separated; a few sparse, short hairs fringing the upper lip beneath nostrils, the hairs laterally longer and rather denser; internarial region nearly naked; upper part of muzzle anteriorly with a sparse cover of long hairs, a short, broad median longitudinal band of similar hairs extending from a point about halfway between nostrils and eyes to widen posteriorly between ears and join fur of crown; lateral parts of upper lip above canines and premolars swollen, sparsely furred, the hairs usually stiff and bristle-like; sides of muzzle around and beneath eyes nearly to angle of mouth with a thin cover of longer hairs; a small wart above the anterior canthus of the eye, bearing a long vibrissa and a few shorter hairs; lower lip with a small, undivided median pad; anteriorly ventral surface of head only sparsely pilose with a small almost totally naked area beneath the symphysis menti,

preceding a low, almost imperceptible elevation that bears a few long hairs; a few longer vibrissae at sides of muzzle.

Ear thick and fleshy, subquadrangular, its anterior margin with well developed posteriorly directed lobe at its base, proximally strongly convex, distally almost straight, the tip broadly rounded, posterior margin of ear strongly convex, with prominent fleshy antitragal lobe, the lobe thickened along its outer margin, inserted quadrately behind and a little below the angle of the mouth; tragus rather fleshy, slightly less in length than one half the length of the ear, more or less hatchet shaped, its anterior margin straight to a narrow, more or less anteriorly directed tip, its upper margin horizontal, the posterior margin strongly convex to well developed subtriangular basal lobe; outer surface of conch quite densely haired in its basal half, distal parts of inner surface and lower part of outer face of tragus sparsely haired.

Thumb relatively long; third metacarpal slightly the longest of metacarpals two to five, fourth very little shorter, fifth rather more so, the second the shortest; second phalange of third digit shorter than first phalange; upper surface of thumb with a thin cover of short hairs; upper surface of forearm naked except for a few hairs near the elbow; toes sparsely haired dorsally; upper surface of uropatagium sparsely haired for its proximal half; base of tail similarly furred both above and below, its tip protruding beyond uropatagium; calcar long, extending across about two thirds of the uropatagial margin; a small linear post-calcarial lobe, lacking any definite supporting cartilaginous spur.

Colour (from specimen in alcohol) both above and below a rich dark blackish chocolate brown, the hairs more brownish at the base but otherwise darker and lustrous.

Skull evidently of medium size with broad, uninflated braincase; postorbital region moderately constricted; supraorbital region abruptly expanded, with well developed superior anteorbital tubercles; anterior orbital margin sharply defined, in frontal aspect nearly vertical; anteorbital foramen large, closed by a narrow bar of bone; maxillary margin of orbit heavy, flange-like, in ventral view forming a wide ledge alongside the toothrow; zygomata slender; narial emargination more or less U-shaped, slightly tapered posteriorly, with broadly rounded apex; post-palatal extension short, with broad median spine; basioccipital pits prominent, sharply incised into basioccipital.

Inner upper incisor (i^2) caniniform, massive, unicuspid, at its base equal in area almost to one half the basal area of the canine, with well developed cingulum, anterior face of tooth rounded, its postero-internal face deeply excavated, its postero-external face shallowly so, the depressions separated by a narrow ridge; outer upper incisor (i^3) more or less ovate, with wide basin-like cingulum and central three-faced cusp, basal area of tooth a little less than one half basal area of i^2, the cusp extending a little above the cingula of i^2 or of c^1, its postero-internal face excavated; tooth intruded from row to lie almost directly behind i^2, its anterior edge in contact with that tooth and on a line joining the anterior edges of c^{1-1}, its posterior edge on a line joining the centres of these teeth, its labial part intruded between i^2 and c^1, with its postero-lateral edge in contact with the antero-lateral face of c^1; i^2 and c^1 otherwise separated by a narrow interspace of about one third the basal diameter of i^2. Upper canine with strong cingulum; upper premolar (pm^4) slightly compressed in toothrow; last upper molar (m^3) in crown area about one half crown area of m^1, with metacone and three commissures, the third short. Lower incisors (i_{1-3}) with tricuspid cutting edge, i_2 overlapping i_1 by almost one half its width, i_3 thickened, with low, small posterior supporting cusp, similarly imbricating i_2; anterior lower premolar (pm_2) in crown area about one third crown area of posterior lower premolar (pm_4), slightly compressed in row; last lower molar (m_3) little reduced, entoconid and hypoconid low, the tooth slightly narrowed posteriorly.

Measurements. External measurements of holotype with (in parentheses) those of two males (BM(NH) 13.2.10.27–28) of *H. tickelli* from Sri Lanka, of similar or younger age: length of forearm 40·1 (47·9, 48·2); of thumb with claw 6·0 (7·9, 8·3); of II^m 35·3 (38·9, 41·3); of III^m 36·3 (41·4, 43·3); of III^1 16·2 (17·5, 19·0); of III^2 13·3 (16·1, 16·6); of IV^m 36·0 (40·8, 41·6); of IV^1 13·4 (14·6, 16·1); of IV^2 7·8 (9·6, 10·7); of V^m 35·1 (39·8, 41·1); of V^1 8·4 (10·1, 10·4); V^2 4·9 (7·8, 7·7); length of tibia 16·5 (19·1, 20·4).

Cranial measurements of holotype with (in parentheses) those of BM(NH) 13.2.10.27: greatest length of skull 15·6 (17·1); condylobasal length 15·2 (—); condylocanine length 13·1 (—); length orbit–gnathion 4·0 (4·7); palatal length 5·9 (7·0); width across anteorbital foramina 5·6 (6·3); width across front of orbits 7·8 (8·4); width across supraorbital swellings 6·6 (6·9); least interorbital width 4·7 (4·7); zygomatic width 11·4 (—); width of braincase 8·3 (9·2); height of braincase 5·8 (6·1); mastoid width 9·0 (9·8); c^1–c^1 (alveoli) 5·4 (6·1); m^3–m^3 7·8 (8·6); c–m^3 6·0 (7·0); length complete mandible from condyles 11·5 (13·0); length right ramus from condyle 12·0 (13·6); c–m_3 6·5 (7·8).

Discussion. The genus *Hesperoptenus* was reviewed in detail by Hill (1976*b*): it has not been recorded previously from Sulawesi. The nominate subgenus with the sole species *H. doriae* Peters, 1869 is known from Malaya and Borneo. In the subgenus *Milithronycteris* the small, very distinctive *H. blanfordi* (Dobson, 1877*b*) has been reported from southern Burma, Thailand and Malaya, *H. tickelli* (Blyth, 1851) from India and Sri Lanka east to the Andaman Islands and Thailand, and *H. tomesi* Thomas, 1905 from Malaya and Borneo. In coloration, shortening of the second phalanx of the third digit, the presence of well-developed supraorbital tubercles, more nearly vertical anteorbital margin, a narrow cingulum on the outer upper incisor (i^3) and in the slightly greater degree of reduction of the last upper molar (m^3) this new species approaches *H. tomesi,* although clearly very much smaller. However, its lower incisors (i_{1-3}) are relatively less massive than in *tomesi,* i_3 in particular although large and with a low posterior cingulum cusp nevertheless retaining a more obvious tricuspid edge. In these respects the new species tends towards *H. tickelli.*

Etymology. It gives me much pleasure to associate this new species with Mr B. H. Gaskell, the collector whose work with 'Operation Drake' has produced an excellent sample of the Sulawesian bat fauna.

MINIOPTERINAE

Miniopterus australis australis Tomes, 1858

Miniopterus australis Tomes, 1858 : 125. Loyalty Islands, South Pacific.

Specimens examined. New Hebrides: 2♂♂, 2 ♀♀ BM(NH) 73.1415–1418 Grotte Montmartre, near Port Vila, Efate I, 20 m; 8 ♂♂, 7 ♀♀ BM(NH) 73.1419–1433 Mission Montmartre, near Port Vila, 40 m; 5 ♂♂, 3 ♀♀ 2 undet. BM(NH) 73.1434–1443 Montmartre, near Port Vila; ♂ BM(NH) 73.1444 'Pig Cave', Narabut Camp, Efate I; 7 ♂♂, 4 ♀♀ BM(NH) 73.1445–1455 'Pig Cave', Harris Plantation, N coast of Efate I; 2 ♂♂, ♀ BM(NH) 73.1456–1458 Ijiptho Cave, NW Aneityum I, sea level; ♀, 2 ♂♂ BM(NH) 73.1459–1461 Paul's Bungalow site, near 'Bethel', Tanna I, sea level; 3 ♀♀ BM(NH) 73.1462–1464 Siwi, Tanna I; 3♂♂BM(NH) 73.1465–1467 Senwar Cave, Tenmial, NW coast of Malekula I, 40 m; ♂♂ BM(NH) 73.1468–1473 Amok, Malekula I, 485 m; 2 ♂♂, 2 ♀♀ BM(NH) 73.1474–1477 Abounatori Village, Malo I; 2 ♂♂, 4 ♀♀ BM(NH) 73.1478–1483 Aouta Plantation, Aore I; 5 ♂♂, 4 ♀♀ BM(NH) 73.1484–1492 Hog Harbour, Espiritu Santo I; ♀ BM(NH) 73.1493 Nokowoula, Espiritu Santo I; 2 ♂♂ BM(NH) 73.1494–1495 Rock shelter 'Wonatsuri', near Nokowoula, Espiritu Santo I, 3550 ft; 3 ♂♂, 3 ♀♀ BM(NH) 73.1496–1501 New Hebrides (all in alcohol except BM(NH) 73.1462, skin and skull; obtained Earl of Cranbrook, Royal Society Expedition to New Hebrides, 1971).

Type material and type locality. Tomes (1858) based *Miniopterus australis* on a total of six specimens, all apparently now in the collections of the British Museum (Natural History). The species was said originally to be from Australia but Dobson (1876) indicated that the specimens that he considered to be the 'types' came in fact from the Loyalty Islands, their bottle in the British Museum being so labelled. Later (1878) he listed these specimens as the 'types', again recording them from the Loyalty Islands. Revilliod (1914) drew attention to this contradiction and noted that Oldfield Thomas had confirmed that this latter locality was the provenance indicated on the labels of these specimens and in the relevant accession register of the British Museum (Natural History). As a result Revilliod accepted the Loyalty Islands as the correct type locality. Peterson (1981*a*) in an abstract of a paper entitled 'The

systematic status of *Miniopterus australis* and related forms stated that the 'holotype' of *M. australis* supposedly from the Loyalty Islands proves to differ from population samples from these islands and from New Caledonia but is indistinguishable from the holotype of *M. tibialis* (Tomes, 1858) from Amboina in the Molucca Islands. He proposed therefore to fix the type locality of *M. australis* as eastern Australia.

Five of Tomes' original specimens were accessed by John Edward Gray, then responsible for vertebrates at the British Museum, within the registration group BM(NH) 54.5.19.1–22, a mixed collection listed without locality or ascribed variously either to the Loyalty Islands or to New Zealand, presented by Sir George Grey. Of these, BM(NH) 54.5.19.1 is recorded simply as *'Vespertilio'* without locality or further data, BM(NH) 54.5.19.4–7 being listed again as *'Vespertilio'* but with the additional data 'In spirit' and 'Loyalty Islands'. The specimen BM(NH) 54.5.19.1 is a skin with skull in situ, and has been labelled 'Australia' by J. E. Gray. Tomes' sixth specimen appears to be BM(NH) 7.1.1.555 (i.e. the Tomes collection, accessed in 1907), a skin with rostral fragment and mandible attached and according to Tomes (1858) specimen 'a' of Gray's (1843*b*) listing of *Trilatitus blepotis* from Timor, a specimen received from the Leyden Museum. Its label bears the notes 'F^{m}. B.M. Apr. 1857' and 'Timor, from the Ley. Mus.', apparently in Tomes' own hand. Evidently it was given to Tomes from the British Museum collections and was returned fifty years later when the whole of his collection was received into the National Museum.

No holotype was designated by Tomes for *M. australis* but Dobson (1876, 1878) clearly considered only the specimens in alcohol BM(NH) 54.5.19.4–7 to be the 'types'. Oldfield Thomas evidently considered this question in some detail, no doubt in response to the point raised by Revilliod, and has clearly re-bottled and in two cases labelled these specimens with appropriate annotations. The specimen tabulated as No. 1 by Tomes he considered to be BM(NH) 54.5.19.4, having labelled it 'No. 1 of Tomes'. It bears another label on which the words *'Miniopterus'*, 'Loyalty Islands' and 'Sir G. Grey' in a second hand can just be discerned: a further label is no longer decipherable. This specimen is now in an individual bottle. Its external label has been written by Thomas and is annotated 'No. 1 of Tome's *australis* (No. 2 made lectotype)'. He has also written the label attached to its skull which is annotated 'No. 1 of Tome's *M. australis.* Not typical. No. 2. made lectotype'. The specimen is in fact an example of *M. robustior* Revilliod, 1914, a point made evident by Revilliod in the original account. This taxon is known so far only from the Loyalty Islands.

The remaining three alcoholic specimens are now together in one bottle with a modern external label giving their locality as Loyalty Islands. One, a male, has been labelled by Thomas as BM(NH) 54.5.19.5, the label annotated 'No. 2 of Tomes'. It is the only one of the three to have its skull extracted: the skull label has been written by Thomas and is annotated 'Lectotype'. *australis.* No. 2 of Tomes'. The other two specimens, a female and male, have no labels but are apparently 3 and 4 of Tomes. This author noted that the four specimens so far discussed were preserved in spirit in the British Museum: his 5 'a specimen in skin in the same collection, the whole of them having been collected in Australia by Sir G. Grey, K.C.B., and presented to the National Collection' is clearly BM(NH) 54.5.19.1. Its label locality, not confirmed by the accessions register, of 'Australia' may well have led Tomes to assume that all of the specimens came from that continent, whence Grey collected numerous mammals. Tomes specimen 6 is apparently BM(NH) 7.1.1.555.

Tate (1941*e*) quotes BM(NH) 54.5.19.5 as the type specimen of *M. australis,* evidently accepting the unpublished designation made by Thomas. There seems no reason either to query the validity of this selection or to doubt that the specimen is from the Loyalty Islands: it is recorded with this provenance in the accessions register and the bottle that contained it and the other three alcoholic examples registered at the same time was apparently labelled as such (Dobson, 1876, 1878) by J. E. Gray: moreover, one of these proves subsequently to belong to a taxon so far known only from these islands. Since no formal selection appears to have been made, BM(NH) 54.5.19.5 is here designated the lectotype of *Miniopterus australis* Tomes, 1858 with the Loyalty Islands as its type locality, in agreement with the archival evidence.

Maeda (1982) has provided an erroneous corollary. This author stated (p. 4) that BM(NH) 14.5.23.2 is one of Tomes' series of specimens and was re-described by Revilliod (1914) as *Miniopterus australis robustior,* remarking later (p. 7) that it is the holotype of this taxon. Both of these statements are incorrect. BM(NH) 14.5.23.2 was presented to the British Museum (Natural History) by F. Sarasin and J. Roux in 1914 and is one of the syntypes of *M. robustior*: it has no connection at all with Tomes. Revilliod (1914) makes it clear that *robustior* was based on nine examples from Lifou, Loyalty Islands and that Tomes No. 1 (now BM(NH) 54.5.19.4) must be referred to it, an allocation confirmed according to Revilliod by a cranial comparison made by Oldfield Thomas.

Remarks. The ears of *M. australis* are rounded and lack any definite point; the tragus is more or less parallel-sided for most of its length, its upper part curving forward to a greater or lesser extent, the upper part of the anterior margin concave and the posterior part convex. The anterior projection of the upper part of the tragus is more marked in specimens from the Loyalty Islands, New Caledonia and the New Hebrides than is usual in those from more westerly localities: in the eastern specimens the tragus has a nearly horizontal upper margin, often slightly dentate, points to which Revilliod (1914) first drew attention.

The braincase is small, slightly globose but not markedly inflated, rather low, with low lambdoidal and sagittal crests, the occipital region not inflated, in profile lower than the highest point of the braincase in the frontal region; the rostrum is low, relatively wide and long, with a moderate median longitudinal sulcus; palate long, domed; there are shallow basioccipital pits, not extending anteriorly to any great extent. The upper canines are strong, with massive base and stout shaft; anterior upper premolar (pm^2) large, triangular in section, slightly compressed in row; lingual margins of m^1 and m^2 about equal, m^1 with well developed hypocone, in m^2 the hypocone evident but slightly less developed; mandibular dentition with no especial peculiarities; lower premolars (pm_{2-4}) slightly compressed.

Externally *M. australis,* if *paululus* Hollister, 1913 from the Philippines and *shortridgei* Laurie & Hill, 1957 from Java are included, is the smallest of Australasian *Miniopterus* with the length of the forearm ranging from 34·4–41·5 and of the tibia from 13·5–17·0; the tail is also relatively short, generally about 40 in length but varying from 35–45, only rarely achieving these extremes. Size differences among specimens in the collections of the British Museum (Natural History) are summarised in Table 9.

Discussion. Although until recently (Maeda, 1982) thought to extend to Thailand (Lekagul & McNeely, 1977) specimens from that country in the British Museum (Natural History) represent *M. pusillus* Dobson, 1876 (then considered a subspecies of *M. australis*), as do others from the Nicobar Islands. It appears therefore that *M. australis* as understood here is distributed from the Philippine Islands, Borneo and Java east to Australia, New Caledonia and the Loyalty Islands.

Specimens from the islands of Malaita, Guadalcanal and San Christobal in the Solomon Islands have slightly longer forearms and are sometimes larger cranially than are those from the Loyalty Islands, New Caledonia and the New Hebrides. There is also a slight difference in tragal structure as already mentioned. These points in part have led Maeda (1982) to describe the Malaita and San Christobal examples as a new species, *M. solomonensis.* Specific rank seems scarcely justified for these specimens which are approached in several respects by those from some of the surrounding populations but certainly a distinct subspecies may be recognised. It is also likely that specimens from Queensland, New Guinea, the Aru Islands, Batchian Island and the Moluccan Islands of Amboina and Ceram should be separated as *M. a. tibialis* (Tomes, 1858) (considered a synonym of *M. a. australis* by Laurie & Hill, 1954) but sample sizes are small in some cases and may be misleading in the determination of subspecific limits. In Borneo *M. a. witkampi* Sody, 1930 differs little from these in contrast to the markedly smaller forms *M. a. paululus* Hollister, 1913 from the Philippine Islands and *M. a. shortridgei* Laurie & Hill, 1957 from Java. Sanborn (1952) synonymised *paululus* with *australis* with which he suggested that *tibialis* might also be synonymous. On the other hand, Peterson (1981*a*) has implied that *paululus* and *shortridgei*

Table 9 Measurements of *Miniopterus australis* (number of specimens examined in parentheses).

	Length of forearm	Condylobasal length	Width of braincase	Mastoid width	m^3–m^3	c–m^3
Philippine Is (*paululus*)	(6) 34·8–36·4	(1) 12·5	(1) 6·6	(1) 7·3	(1) 5·3	(1) 4·9
Java (*shortridgei*)	(31) 34·4–36·6	(20) 12·1–12·6	(23) 6·4–7·0	(23) 6·9–7·1	(23) 5·1–5·4	(23) 4·7–4·9
Timor (? *shortridgei*) (ex Goodwin, 1979)	(5) 35·4–38·0	(5) 12·5–12·8		(5) 7·0–7·5	(5) 5·2–5·3	(5) 4·8–5·1
Borneo (*witkampi*)	(23) 35·2–38·9	(5) 13·5–14·0	(5) 7·1–7·3	(5) 7·5–7·8	(6) 5·7–6·0	(6) 5·3–5·6
Sulawesi (*tibialis*)	(2) 37·4–40·0	(1) 13·0	(1) 6·9	(1) 7·3	(1) 5·7	(1) 5·3
Amboina (*tibialis*)	(10) 36·6–38·9	(2) 13·4–13·5	(2) 7·1–7·3	(2) 7·4–7·7	(3) 5·7–5·9	(4) 5·3–5·5
Ceram (*tibialis*)	(2) 37·2–38·4	(1) 13·2	(1) 6·9	(1) 7·3	(1) 5·7	(1) 5·3
Batchian I (? *tibialis*)	(2) 39·0–39·3	—	—	—	—	(1) 5·7
Aru Is (? *tibialis*)	(14) 37·7–41·3	(3) 13·0–13·4	(4) 7·0–7·2	(4) 7·3–7·5	(3) 5·6–5·8	(3) 5·1–5·3
Beu I, Mayabit Bay, Waigeo, West Irian (? *tibialis*)	(1) 39·3	—	—	—	—	—
Papua (ex McKean, 1972) (? *tibialis*)	(61) 37·9–40·9	(3) 12·9–13·5	(5) 6·8–7·1	—	—	(5) 5·0–5·4
Yule I, Papua (? *tibialis*)	(4) 39·7–40·8	(2) 13·7	(2) 7·2–7·4	(2) 7·8–7·9	(2) 5·8	(2) 5·5
Queensland, Australia (? *tibialis*)	(14) 37·7–39·8	(7) 13·1–13·3	(8) 6·9–7·2	(8) 7·5–7·8	(9) 5·5–5·6	(8) 5·1–5·3
San Christobal I, Malaita I, Guadalcanal I, Solomon Is (? *solomonensis*)	(15) 38·6–41·4	(8) 13·7–14·3	(8) 7·0–7·2	(8) 7·5–7·8	(11) 5·5–6·2	(10) 5·1–5·7
Rennell I (*australis*)	(26) 34·5–37·5	(7) 12·4–12·8	(9) 6·4–6·8	(9) 7·0–7·4	(9) 5·1–5·4	(10) 4·8–5·0
New Hebrides (*australis*)	(147) 34·9–38·9	(8) 12·9–13·3	(9) 6·7–7·0	(8) 7·2–7·5	(7) 5·5–5·7	(10) 5·1–5·3
Loyalty Is, New Caledonia (*australis*)	(21) 36·3–38·6	(14) 13·0–13·6	(16) 6·7–7·0	(13) 7·3–7·7	(14) 4·9–5·6	(10) 5·2–5·4

may be distinct from *australis,* while Maeda (1982) has raised *paululus* to specific rank and considered *shortridgei* its synonym. With these bats from the Philippines and Java, however, he associated small specimens from Rennell Island in the Solomon Islands to produce a somewhat anomalous distribution pattern for his proposed *M. paululus.* Koopman (1982) also recognised *paululus* as a distinct species in the islands off eastern Papua, the New Hebrides and Timor, although strongly tempted to treat *australis* and *paululus* as conspecific. The largest of specimens from Rennell Island and the New Hebrides, however, approach or overlap (Table 9) the smallest of *australis* from the Loyalty Islands and New Caledonia. Specimens from Timor are similar to *shortridgei* from Java but are sometimes slightly larger, as Goodwin (1979) pointed out.

Miniopterus australis tibialis (Tomes, 1858)

Vespertilio tibialis Tomes, 1858 : 126. Amboina I, Molucca Is.

Specimens examined. C Sulawesi: ♂ BM(NH) 82.136 Taronggo, 1° 44′ S, 121° 40′ E; ♀ BM(NH) 82.137 R Ranu, 1° 51′ S, 121° 30′ E (in alcohol, skull of BM(NH) 82.136 lacking, of 82.137 extracted; coll. B. H. Gaskell, 'Operation Drake').

Remarks. These specimens are the first of *M. australis* to be reported from Sulawesi, where on distributional grounds the species might be expected to occur. For the present they are referred to *M. a. tibialis* which is considered a probably distinct subspecies: they are similar in size (Table 9) to those from the Molucca Islands, New Guinea, the Aru Islands and Queensland discussed above.

Miniopterus pusillus pusillus Dobson, 1876

Miniopterus pusillus Dobson, 1876 : 162. Nicobar Islands.

Specimens examined. Thailand: ♂, ♀ BM(NH) 78.2381–2382 Ban Huai Luang Cave, Chae Hom, Lampang (skins, skulls); ♀ BM(NH) 79.1422 Tham Hai Luang, Chag Hok, Lampang (in alcohol, skull extracted) (all presented by the Thai National Reference Collection, Bangkok).

Sumatra: ♂ JJW 15 Lian Penerukan, near Bohorok, Langkat (in alcohol, skull extracted; coll. J. J. Whitten).

W Java: ♀ BM(NH) 61.1781 Gua Tjibureum, Tjibodas, 2000 m; ♀ BM(NH) 61.1791 Klapanunggal, Tjileungsi (skins, skulls; coll. Earl of Cranbrook & P. Jauffret).

Type material and type locality. Tate (1941*e*) gave the type locality of *Miniopterus pusillus* Dobson, 1876 as 'Madras, India' as did Ellerman & Morrison-Scott (1951) who also said 'But Wroughton gave Nicobar Islands as type locality'. Wroughton (1918) gave the type locality as 'Nicobars' and cited a specimen in the Indian Museum (No. 185) collected by Stoliczka as the lectotype.

The original description by Dobson provides no precise type locality but lists measurements of a specimen from the Nicobar Islands and of one from Madras. It includes a reference to an earlier paper (1871*c*) by Dobson in which he discussed specimens from the Nicobar Islands (collected by Stoliczka) that he referred to *M. australis* with some reservation. In his Catalogue of the Chiroptera in the collections of the British Museum (1878) Dobson listed the specimen from Madras and also others reputedly from the Philippine Islands under *Miniopterus schreibersii* var. a (i.e. *pusillus*) but gave measurements only for a Nicobarese specimen, taken evidently from his original work, and included the Andamans and Nicobars in the distribution of this form. Significantly, he did not indicate that the Madras specimen was the type. Clearly Dobson intended *pusillus* to apply to the Nicobarese specimens to

which (1871*c*) he first drew attention, so that Wroughton's (1918) designation of a lectotype and type locality is justified. The choice of Madras as type locality and by implication of BM(NH) 52.8.12.8 from there as lectotype appears to rest only on its citation as the first specimen listed in Dobson's Catalogue (1878).

Remarks. *Miniopterus pusillus* is similar in many respects to *M. australis* but may be distinguished from this species by its generally longer forearm that ranges from 39·3–45·5, longer tibia ranging from 16·5–22·0 and longer tail, its length varying from 43·5–52·0; its braincase is more globose, more elevated and higher, rising abruptly from the rostrum and is more elevated posteriorly, the height at the occiput nearly equal or equal to its height at the frontal; the rostrum is relatively short and is weak anteriorly when compared with that of *M. australis,* posteriorly wider and a little deeper; the upper canines are long and slender; as in *M. australis* m^1 has a well developed hypocone but the hypocone of m^2 is small or absent, the lingual shelf of this tooth more or less parallel-sided with no postero-internal projection.

The species is sympatric (chiefly as *M. p. macrocneme*) with *M. australis* over the eastern part of its range: although the two can generally be distinguished by the slightly greater external size of *pusillus* in locations where they occur together, such comparisons of specimens of each from different, widely separated localities can result in overlap. Dimensions of specimens in the collections of the British Museum (Natural History) appear in Table 10.

Besides specimens already noted, the collections in London include examples of *M. p. pusillus* from the Nicobar Islands (BM(NH) 90.6.20.2, 6.12.1.32–33) and from the island of Koh Lak, off the southeastern coast of Thailand (BM(NH) 17.2.6.4–7). Maeda (1982) referred BM(NH) 67.1810 from Bukit Cheras, near Panching, Kuantan, Pahang, Malaya to *pusillus,* but comparison suggests that more properly it represents *M. medius* with which it was first identified by Hill (1972). The specimens reputedly from the Philippine Islands listed by Dobson (1878) with, in parentheses, the locality 'Erumango' are BM(NH) A–C, not having been accessed formally or registered. They were obtained from Mr Hugh Cuming, a well known collector of Philippine mammals during the latter part of the last century. I have been unable to locate 'Erumango' in the Philippine Islands but there is an island called Eromango in the New Hebrides: Hoffman (1887) suggested that Dobson's designation was an error for New Hebrides. In cranial dimensions (Table 10) these specimens agree more closely with examples of *M. p. macrocneme* from New Guinea, the Solomon Islands and the New Hebrides rather than with more western specimens of this subspecies or with *M. p. pusillus* and also have the longer tibia characteristic of *macrocneme* rather than the shorter tibia of *pusillus.* Maeda (1982) also thought that they should be referred to *macrocneme.* A further specimen, BM(NH) 74.5.27.6, labelled 'Philippine Islands' and purchased from a Mr Salmin may represent *M. pusillus*, tentatively recorded from Baguio, Benguet Island by Taylor (1934).

The specimen reported here from Sumatra appears to be the first of *M. pusillus* to be recorded from that island, and the examples BM(NH) 61.1781 from Gua Tjibureum, Tjibodas and BM(NH) 61·1791 from Klapanunngal seem also to be the first of the species to have been recorded from Java. The Javan specimens were initially reported by Maeda (1982), who also referred others from Amboina, Ceram and the Kei Islands to *pusillus*, but these seem on comparison to be nearer to *macrocneme,* like those from New Guinea. On the other hand, specimens reported from Timor by Goodwin (1979) as *M. pusillus* have longer forearms like *macrocneme* but skulls that are similar in length to those of the western subspecies.

Discussion. Recently accessed specimens from Thailand have made possible a wider assessment of *M. pusillus* than was hitherto feasible in London, although the available material remains inadequate for any detailed analysis of subspecific variation. In particular the newly acquired material has demonstrated that the limited number of Siamese specimens hitherto in the collections should not be referred to *M. australis* as once they were, but instead to *M. pusillus* which itself is specifically distinct.

Table 10 Measurements of *Miniopterus pusillus* (number of specimens examined in parentheses).

	Length of forearm	Length of tibia	Condylobasal length	Width of braincase	Mastoid width	m^3–m^3	c–m^3
M. p. pusillus							
Nicobar Is	(3) 39·3–40·1	(3) 16·8–17·6	(3) 12·7–12·9	(3) 7·0–7·2	(3) 7·5–7·6	(3) 5·5–5·6	(3) 5·0–5·1
Madras	(1) 42·5	(1) 18·4	—	(1) 7·4	—	—	(1) 5·3
Thailand	(7) 40·7–42·6	(7) 16·5–18·4	(7) 12·8–13·3	(7) 7·2–7·4	(5) 7·5–7·9	(6) 5·5–5·6	(7) 5·0–5·2
Sumatra	(1) 41·8	(1) 17·5	(1) 13·3	(1) 7·4	(1) 7·9	(1) 5·6	(1) 5·3
Java	(1) 42·4	(1) 18·0	(1) 13·3	(1) 7·3	(1) 7·6	(1) 5·6	(2) 4·9–5·2
M. p. macrocneme							
Sulawesi	(5) 43·1–45·0	(5) 18·8–19·8	(5) 12·9–13·2	(5) 7·2–7·4	(5) 7·5–7·7	(5) 5·4–5·5	(5) 5·0–5·1
Amboina I, Ceram I	(7) 40·5–43·6	(7) 17·5–19·2	(5) 13·1–13·4	(6) 7·0–7·4	(5) 7·3–7·8	(6) 5·6–5·7	(3) 5·2–5·3
Kei Is	(5) 40·5–42·1	(5) 17·2–17·9	(3) 12·9–13·3	(3) 7·0–7·3	(3) 7·4–7·6	(3) 5·5–5·7	(3) 5·2–5·4
Timor I (ex Goodwin, 1979)	(58) 41·2–44·1	—	(6) 12·6–12·9	—	(6) 7·6–7·8	(6) 5·4–5·6	(6) 5·0–5·1
Batchian I	(1) 41·8	(1) 19·2	—	—	—	—	—
New Guinea	(21) 40·6–45·5	(19) 17·2–19·2	(2) 13·7–14·1	(2) 7·3–7·6	(1) 8·2	(2) 5·7	(2) 5·5
San Christobal I, Solomon Is	(2) 40·9–43·1	(2) 18·1–18·9	(1) 13·6	(2) 7·1–7·3	(2) 7·3–7·8	(2) 5·7–5·8	(2) 5·3–5·4
New Hebrides	(48) 40·5–43·5	(48) 18·5–20·0	(1) 13·9	(1) 7·3	(1) 8·0	(1) 5·9	(1) 5·6
'Erumango' (see text)	(3) 41·8–42·2	(3) 18·9–19·2	(2) 13·6–13·8	(2) 7·3–7·4	(2) 8·0	(2) 5·9	(2) 5·5–5·6
New Caledonia	(2) 40·7–41·7	(2) 18·2–18·6	—	—	—	—	—
Loyalty Is	(1) 40·7	—	(1) 13·2	(1) 7·1	(1) 7·8	(1) 5·6	(1) 5·3

Miniopterus pusillus macrocneme Revilliod, 1914

Miniopterus macrocneme Revilliod, 1914 : 360. New Caledonia and Loyalty Islands.

SPECIMENS EXAMINED. C Sulawesi: ♂, ♀ BM(NH) 83.138–139 R Ranu, 1° 51′ S, 121° 40′ E (in alcohol, skulls extracted; coll. B. H. Gaskell, 'Operation Drake').

New Hebrides: 5 ♂♂, 5 ♀♀, 1 undetermined BM(NH) 73.1502–1512 'Pig Cave', Harris Plantation, N coast Efate I, 40 m; ♂, 2 ♀♀ BM(NH) 73.1513–1515 'Pig Cave', Narabut Camp, Efate I, 800 ft; 2 ♂♂, 2 ♀♀ BM(NH) 73.1516–1519 'Pig Cave', Efate I; 2 ♂♂, 2 ♀♀ BM(NH) 73.1520–1523 Paul's bungalow site, near 'Bethel', Tanna I, sea level; 2 ♂♂ BM(NH) 73.1524–1525 Siwi, Tanna I; 2 ♂♂, 2 ♀♀ BM(NH) 73.1526–1529 Arvat, E coast Erromanga I, sea level; ♂, ♀ BM(NH) 73.1530–1531 Womban Wovoula Cave, Abouanatori village, Malo I, 50 m; ♂, ♀ BM(NH) 73.1532–1533 Abouanatori village; ♂ BM(NH) 73.1534 Aouta, Aore I; ♂, ♀ BM(NH) 73.1535–1536 Limboh, near Litzlitz, Port Stanley Bay, Malekula I; ♀♀ BM(NH) 73.1537–1541 Lomboh Cave, near Litzlitz, 5 m; 3 ♂♂, 2 ♀♀ BM(NH) 73.1542–1546 Lipelip Cave, Amok, Malekula I, 440 m (all in alcohol; obtained Earl of Cranbrook, Royal Society Expedition to New Hebrides, 1971).

REMARKS. The first record of *M. pusillus* from Sulawesi was provided by Hill (1974) who reported specimens (as *M. medius macrocneme*) from Wawondula in the southern part of the island. For the present Sulawesian specimens are referred to *M. p. macrocneme* but the total of material available is quite inadequate for the proper evaluation of subspecies or their boundaries. However, these specimens and those obtained earlier have the long tibiae (Table 10) usual in this more eastern subspecies.

Miniopterus pusillus macrocneme occurs with *M. australis* throughout the range of the subspecies but may be distinguished by the characters noted above under *M. p. pusillus.* According to Revilliod (1914) *macrocneme* may be differentiated from *australis* by the shape of the tragus, which in the latter he stated projects anteriorly in its distal part, with a nearly horizontal, irregularly dentate upper margin while in *macrocneme* the tragus is less strongly projected forward and there is no well marked dentate upper margin. The anterior projection of the upper part of the tragus is more pronounced in specimens of *australis* from New Caledonia and the Loyalty Islands (whence Revilliod drew his observations) and the New Hebrides than in those from more westerly locations and in such examples the tragus has a nearly horizontal upper margin, sometimes slightly dentate, both features that disappear from more westerly populations. Neither has therefore any extensive diagnostic value.

DISCUSSION. Hill (1971*a*, 1974) considered *macrocneme* (an eastern form extending apparently from Sulawesi east to the New Hebrides, New Caledonia and the Loyalty Islands) conspecific with *medius* Thomas & Wroughton, 1909 from Java but Peterson (1981*b*) has suggested that *macrocneme* represents the *pusillus* species group and that *medius* belongs to the *fuscus* group of species. Newly acquired specimens have established *medius* in southern Thailand in near sympatry with *pusillus,* while others whose skulls have become available recently have shown it to occur sympatrically with *pusillus* in Java; moreover the additional material has suggested that *medius* must be considered specifically distinct, and that *pusillus* and *macrocneme* are most probably conspecific.

Maeda (1982) seems uncertain in his group allocation of *macrocneme* but finally places it as a species in the *fuscus* group along with *M. fuscus* and *M. medius.* However, the discriminatory ratios given by Maeda for *macrocneme* overlap considerably into those that he gives for the *pusillus* group, and direct comparison of specimens reveals close similarities of structure. For this reason I agree with Peterson (1981*b*) that *macrocneme* and *pusillus* should be associated, and incline further to the view, used here, that they are conspecific.

Miniopterus medius Thomas & Wroughton, 1909

Miniopterus medius Thomas & Wroughton, 1909 : 382, Kalipoetjang, Tji-Tandoei R, Java.

SPECIMENS EXAMINED. Thailand: ♂ BM(NH) 78.1424 Ban Kok Chang, Nakhon Sri Thamrat (in alcohol, skull extracted; presented by Thai National Reference Collection).

Table 11 Measurements of *Miniopterus medius* and *M. fuscus* (numbers of specimens examined in parentheses).

	Length of forearm	Condylobasal length	Braincase width	Mastoid width	m^3–m^3	c–m^3
M. medius						
Thailand	(1) 41·9	(1) 14·3	(1) 7·5	(1) 8·2	(1) 6·4	(1) 6·0
Malaya	(4) 42·2–43·3	(1) 13·8	(1) 7·7	(1) 8·1	(1) 5·9	(1) 5·4
Pulau Kaban, Johore Archipelago	(5) 41·3–42·6	(5) 13·8–14·1	(5) 7·4–7·8	(5) 8·0–8·3	(4) 5·8–5·9	(5) 5·5
Java	(13) 40·8–45·0	(9) 14·0–14·5	(10) 7·3–7·6	(10) 7·7–8·4	(9) 6·1–6·5	(10) 5·7–6·0
New Guinea	(1) 47·5	(1) 14·4	(1) 7·5	(1) 8·4	(1) 6·1	(1) 5·7
M. fuscus (*yayeyamae*)						
Okinawa I, Ishigaki Is	(13) 38·0–44·5	(4) 13·8–14·1	(4) 7·4–7·5	(4) 7·9–8·2	(8) 5·9–6·3	(6) 5·4–5·8

Malaya: ♂, ♀ BM(NH) 69.1250–1251 Base of Gunong Ledang (=G. Ophir), Johore, 2° 21′ N, 102° 39′ E; ♂ BM(NH) 75.1296 Sungei Kelambang Camp, Ulu Setiu, Besut, Trengganu, c. 5° 25′ N, 102° 42′ E (all in alcohol; obtained by the Earl of Cranbrook).

Java: 3 ♂♂, 4 ♀♀ BM(NH) 61.1766–1768 (in alcohol, skulls of BM(NH) 61.1766, 61.1768 extracted), BM(NH) 61.1782–1783 (skins, skulls), BM(NH) 61.1784–1785 (in alcohol, skulls extracted) Klapanunngal, Tjileungsi, 280 m (coll. Earl of Cranbrook & P. Jauffret).

Papua New Guinea: ♀ BM(NH) 80.657 Mt Kainoi, Wau, 7° 19′ S, 146° 44′ E (in alcohol, skull extracted; coll. B. H. Gaskell, 'Operation Drake').

Remarks. There appear to be no definitive published records of *M. medius* from the area east of Java. Baker & Bird (1936) recorded *medius* from Espiritu Santo Island in the New Hebrides but two of their specimens still available (BM(NH) 36.4.8.1–2) in fact prove to be *M. pusillus macrocneme*. Similarly, the specimens from Papua New Guinea reported as *medius* by McKean (1972) seem likely to represent *macrocneme* (Koopman, 1982 thinks MH 984 from Putei perhaps referable to *M. schreibersii*): certainly examples (BM(NH) 50.1802–1803) from Tomba, in the Hagen Range, Papua New Guinea, first reported by Laurie (1952) as *M. schreibersii blepotis* but later thought to represent *medius* in fact belong to *macrocneme* while another (BM(NH) 39.1403) from Nadimo Valley, The Gebroeders, Weyland Range, West Irian although previously identified as *medius* is also *macrocneme*. These specimens were among those leading Hill (1971*a*) to consider *macrocneme* conspecific with *medius*. The specimen reported here from Mount Kainoi provides evidence of near sympatry between *medius* and *M. pusillus macrocneme* in eastern New Guinea: as pointed out above, *medius* also occurs near or with *M. p. pusillus* in Thailand and Java.

Measurements of *M. medius* in the collections of the British Museum (Natural History) appear in Table 11. The largest of *M. pusillus* equal or overlap the smallest of *M. medius* in some respects but the two can be distinguished by the generally larger skull and more massive teeth of the latter. Equally, the largest of *medius* approach or overlap the smallest of *M. schreibersii* in some dimensions but *medius* has a narrower skull and braincase: in any event, there appears to be no overlap when specimens from the same general area are compared. Although the example of *medius* recorded here from New Guinea has a forearm that is considerably longer than the forearms of *medius* from Java or from the more western parts of its range, the specimen agrees very closely with Javan examples both in the structure and the dimensions of its skull and teeth.

Discussion. Peterson (1981*b*) suggested that *medius* belonged to the *fuscus* species group, an opinion confirmed by Maeda (1982). An examination of the holotype (BM(NH) 2.10.7.3) of *M. fuscus* Bonhote, 1902 from Okinawa Island, Liu Kiu Islands shows that in all relevant features it is clearly allied to *M. medius* and is also dimensionally very similar. Possibly with or including *yayeyamae* Kuroda, 1924 from Ishigaki Island, also in the Liu Kiu Islands, it may be a northern representative of *medius*: certainly on cranial features and size it has no connection with *M. schreibersii* (Kuhl, 1819) as was suggested by Tate (1941*e*) or by Ellerman & Morrison-Scott (1951) who, perhaps influenced by Tate's remark that it was virtually equal to *blepotis* (Temminck, 1840) and to *eschscholtzii* (Waterhouse, 1845) synonymised both *fuscus* and *yayeyamae* with *M. schreibersii blepotis*.

Miniopterus schreibersii blepotis (Temminck, 1840)

Vespertilio blepotis Temminck, 1840 : 212, pl. 53, figs 1, 2. Java, Timor and Amboina. Lectotype tentatively designated and type locality restricted to Java by Tate (1941*e*): Maeda (1982) has designated a further lectotype and a series of paralectotypes (including the specimen selected by Tate) from Java.

Specimen examined. C Sulawesi: ♂ BM(NH) 82.141 Taronggo, 1° 44′ S, 121° 40′ E (in alcohol, skull extracted; coll. B. H. Gaskell, 'Operation Drake').

Remarks. This appears to be the second record of *M. s. blepotis* from Sulawesi, Tate (1941*e*) having recorded a specimen from the southern part of the island. In most dimensions (Table

12) it agrees with specimens from western Java but has a longer forearm and longer skull similar to those of specimens from Amboina Island. These latter were referred to a newly described species *M. oceanensis* (see below) by Maeda (1982), who has made an extensive study of Eurasian and Australasian *Miniopterus* and has provided a key. Use of this key, which relies heavily on proportional ratios for discrimination, identifies the Sulawesian specimen to the *fuliginosus, blepotis* or *schreibersii* groups and thence to *M. fuliginosus* or *M. eschscholtzii* if the ratio forearm length/greatest length of skull is employed (and from there to *M. fuliginosus* on forearm length and the ratio m^3–m^3/condylobasal length) but to *M. blepotis* if the ratio mastoid width/greatest length of skull is used.

Measurements of BM(NH) 82.141: length of forearm 46·7; greatest length of skull 15·9; condylobasal length 15·5; condylocanine length 14·5; least interorbital width 3·9; zygomatic width 8·9; width of braincase 7·9; mastoid width 8·6; c^1–c^1 (alveoli) 4·5; m^3–m^3 6·8; c–m^3 6·2; length complete mandible from condyles 11·5; length right ramus from condyle 11·5; c–m^3 6·8.

Discussion. Until recently the conventional view of *M. schreibersii* (Kuhl, 1819) of eastern Asia and Indo-Australia included those forms with forearm lengths ranging from 44 or slightly less to 50 or thereabouts, the condylobasal length of the skull varying from about 14·5 to a maximum of some 16, the exception being *M. s. magnater* Sanborn, 1931 from New Guinea which exceeds these upper limits. Peterson (in Goodwin, 1979) considered *magnater* to represent a distinct species while Kobayashi *et al.* (1980) have also raised *magnater* to specific rank, recording it with *schreibersii* from Sabah in northern Borneo. More recently Maeda (1982) has described the Sabah population initially referred to *magnater* as a new species, *M. macrodens,* associating with it specimens from a wide variety of localities from Hong Kong to South Australia. It is discussed in more detail below[1]. Tate (1941*a*) suggested that the small forms *fuscus* Bonhote, 1902 from Okinawa Island, Liu Kiu Islands and *yayeyamae* Kuroda, 1924 from Ishigaki-Mura, Ishigaki Island, also in the Liu Kiu Islands might be synonymous representatives of *M. schreibersii,* equal to *M. s. blepotis* with which both were synonymised by Ellerman & Morrison-Scott (1951). Specimens in the British Museum (Natural History), including the holotype of *fuscus,* show clearly that these do not represent *M. schreibersii* but instead are near to *M. medius* of Thailand, Malaya, Java and New Guinea, as Maeda (1982) suggests, and of which they may be northern representatives. Of these, *fuscus* is the earliest name.

The collections of the British Museum (Natural History) show that in fact the concept of *M. schreibersii* hitherto widely accepted includes two sympatric forms, as the conclusions of Peterson (1979) and Kobayashi *et al.* (1980) imply, and as Maeda (1982)[1] has established, in part from the same collections. One, regarded here as *M. schreibersii*, is smaller, with a relatively narrower palate (Table 12). In eastern Asia and in the Indo-Australian region it occurs from Afghanistan, India and Sri Lanka to Japan, the Philippine Islands and east to the Solomon Islands and Australia. The other, consisting of larger examples, with longer skull and toothrows and wider palate, but with the forearm on the whole only very slightly longer (Table 13), is represented in the collections from Hong Kong, Burma, Thailand, Malaya, Sumatra and Java[1]. Such specimens represent *M. macrodens* Maeda, 1982: they agree closely in structure and size with *M. magnater* from New Guinea and are discussed more fully under that species. All have been referred to *M. schreibersii* in the past when this species was presumed to embrace a greater size range to include *magnater* as a subspecies (e.g. BM(NH) 67.217 from Pahang by Hill (1972)) or before then (e.g. BM(NH) 9.1.5.460–461 from Java by Thomas & Wroughton (1909) who in allocating these to *blepotis* remarked upon their long forearms in comparison with other Javanese specimens) like those reported and measured from Hainan by Allen (1938*b*), which seem on size to be very similar to these large examples and are referred without examination to *macrodens* by Maeda (1982). Specimens from Java reported as *blepotis* by Sody (1930) are very large for this form and much nearer in size to the large examples from Soekaboemi (BM(NH) 9.1.5.460–461) noted above

[1]See Addendum, p. 208

Table 12 Measurements of *Miniopterus schreibersii** (numbers of specimens examined in parentheses).

	Length of forearm	Condylobasal length	Width of braincase	Mastoid width	m^3–m^3	c–m^3
Afghanistan; India	(19) 46·2–48·5	(10) 14·6–15·3	(11) 7·7–8·2	(10) 8·4–9·0	(11) 6·3–6·8	(11) 5·8–6·2
Burma	(1) 48·0	(1) 15·2	(1) 8·1	(1) 8·7	(1) 6·8	(1) 6·2
Thailand (*haradai*, ex Maeda, 1982)	(4) 42·5–43·7	(4) 14·7–15·3	(4) 7·5–8·1	(4) 8·2–8·5	(4) 6·3–6·5	(4) 5·9–6·2
Vietnam	(7) 46·7–48·4	(6) 14·7–15·5	(5) 7·7–8·2	(5) 8·5–9·1	(6) 6·5–6·8	(6) 5·8–6·2
Fukien, China	(1) 47·3	(1) 15·6	(1) 8·2	(1) 8·8	(1) 6·6	(1) 6·2
Chihli, China	(15) 45·9–49·0	(11) 14·9–15·6	(10) 7·9–8·2	(11) 8·8–9·0	(15) 6·4–6·8	(15) 5·9–6·3
Japan	(14) 44·8–47·9	(10) 14·5–15·4	(10) 7·5–8·0	(10) 8·3–8·8	(10) 6·5–6·7	(10) 5·8–6·2
Philippine Is	(2) 44·7–45·5	(1) 14·6	(1) 7·6	(1) 8·4	(1) 6·7	(1) 6·0
Malaya	(1) 44·8	(1) 15·0	(1) 8·1	(1) 8·7	(1) 6·6	(1) 6·0
Sumatra	(2) 47·0, 48·5	(1) 15·2	(1) 8·3	(1) 8·6	(1) 6·8	(2) 6·2
Java	(16) 43·6–45·8	(14) 14·8–15·6	(14) 7·8–8·2	(13) 8·3–8·7	(15) 6·6–6·9	(15) 5·9–6·3
Java (*ravus*, ex Sody, 1930)	(2) 43	—	(2) 8·2–8·5	—	—	(2) 6·1–6·4
Sulawesi	(1) 46·7	(1) 15·5	(1) 7·9	(1) 8·6	(1) 6·8	(1) 6·2
Amboina	(3) 45·5–46·5	(3) 15·4–15·9	(3) 7·8–8·2	(3) 8·5–9·1	(3) 7·1–7·2	(3) 6·3–6·4
Kei Is	(6) 44·3–44·9	(5) 14·9–15·4	(5) 7·6–8·0	(5) 8·3–8·8	(5) 6·6–7·0	(5) 6·1–6·3
New Guinea	(3) 47·4–47·9	(3) 15·2–15·6	(3) 8·0–8·2	(3) 8·3–8·9	(3) 7·0–7·3	(2) 6·2
Timor I (ex Goodwin, 1979)	(20) 46·6–49·7	(3) 15·5–15·8	—	(3) 8·8–9·0	(3) 7·2–7·3	(3) 6·5–6·7
E Australia (*oceanensis*)	(63) 45·4–48·6	(17) 15·1–15·9	(18) 8·0–8·4	(18) 8·7–9·2	(19) 6·8–7·2	(22) 6·2–6·4
N Australia (*orianae*)	(11) 43·1–46·7	(8) 15·0–15·5	(7) 7·7–8·1	(8) 8·3–8·8	(6) 6·2–6·8	(7) 5·7–6·0
New Ireland	(2) 46·1–46·4	(2) 14·6–14·8	(2) 7·4–7·7	(2) 8·2–8·3	(2) 6·6–6·7	(2) 6·1
Rennell I, Solomon Is	(7) 45·7–48·4	(8) 14·6–15·7	(11) 7·6–8·0	(10) 8·1–8·7	(10) 6·5–7·0	(9) 5·9–6·4

*Possibly valid subspecies are discussed in the text.

Table 13 Measurements of *Miniopterus magnater* and *M. bismarckensis* (number of specimens examined in parentheses).

	Length of forearm	Condylobasal length	Width of braincase	Mastoid width	m^3–m^3	c–m^3
M. m. macrodens						
Hong Kong	(1) 51·0	(1) 16·7	(1) 8·7	(1) 9·7	(1) 7·5	(1) 6·6
Yunnan	(1) 51·0	—	—	—	(2) 7·1	(2) 6·4–6·5
Burma	(1) 49·4	(1) 16·5	(1) 8·5	(1) 9·7	(1) 7·4	(1) 6·7
Thailand	—	(2) 15·9–16·1	(2) 8·3–8·5	(2) 8·9–9·1	(2) 7·3–7·4	(2) 6·5
Koh Lak I, off SE Thailand	(1) 50·1	(1) 16·0	(1) 8·3	(1) 9·1	(1) 7·4	(1) 6·5
Malaya	(2) 49·4–50·8	(1) 16·3	(1) 8·5	(1) 9·3	(1) 7·4	(1) 6·5
Sumatra	(4) 48·8–51·0	(1) 17·4	(1) 8·4	(1) 9·2	(1) 7·6	(1) 7·2
Java	(2) 50·1–50·4	(2) 15·8–16·1	(2) 8·3–8·4	(2) 9·1–9·2	(2) 7·1–7·3	(1) 6·7
M. m. magnater						
New Guinea	(20) 48·5–51·7	(3) 16·7–17·0	(5) 8·3–8·6	(3) 9·2–9·4	(5) 7·5–7·9	(5) 6·8–7·0
*M. bismarckensis**						
Manus I, Bismarck Archipelago	(3) 44·4–46·4	—	—	—	(2) 7·2, 7·1	(2) 7·1, 7·3

*see text.

and are also referred to *macrodens* by Maeda, while *M. ravus* Sody, 1930, described concurrently, seems on measurements to be close to *blepotis*, to which Maeda refers its holotype specimen.

Maeda (1982) has proposed wide ranging changes in the classification of *Miniopterus* from Eurasia and especially Indo-Australia, many closely affecting that part of the genus formerly held to include *schreibersii, blepotis* and a number of other related taxa. These changes may be briefly summarized by comparison with the pre-existing classification, chiefly derived from Tate (1941*e*) and from Ellerman & Morrison-Scott (1951), excluding purely Eurasian taxa and also *fuscus* and its allied forms:

Previous concept	Maeda (1982)
M. schreibersii pallidus (Afghanistan)	*M. schreibersii*
M. schreibersii fuliginosus (Afghanistan to S China, Japan)	*M. fuliginosus*
M. schreibersii chinensis (N China)	*M. fuliginosus*
M. schreibersii eschscholtzii (Philippines)	*M. eschscholtzii*
M. schreibersii blepotis (in part, Malaysia)	*M. blepotis*
M. schreibersii blepotis (in part, Moluccas to Australia, Solomon Is)	*M. oceanensis*
M. schreibersii orianae (N Australia)	*M. eschscholtzii*

To these he adds a further newly described species, *M. haradai* Maeda, 1982 from southern Thailand.

As can be seen, the concept of one widely ranging polytypic species is replaced by Maeda (1982) by five species. Moreover, the arbitrary statistical treatment used in this study removes *oceanensis,* applied to specimens that formerly were referred to *M. s. blepotis,* to the *magnater* subgroup of the *fuliginosus* group as Maeda defines them, while *blepotis* and *eschscholtzii* form another group (the *blepotis* group), and *schreibersii* yet a third. There is no doubt that the statistical analysis of metrical characters made by Maeda has identified and codified many, if not all of the parameters used hitherto in the identification of the forms of *Miniopterus* in Eurasia and Indo-Australia. The allocation of taxonomic rank to the groupings so characterised, however, seems very arbitrary and biased rather more heavily towards the interpretation of metrical data than towards morphological and zoogeographical considerations. Thus Maeda admits (p. 21) that there is no clear difference in general morphological characteristics between all of the species of the *fuliginosus* group (i.e. *magnater, macrodens, oceanensis, fuliginosus*) and those of the *blepotis* group (i.e. *blepotis, eschscholtzii, haradai*), although he pointed out that there are some conspicuous differences between the *magnater* subgroup (*magnater, macrodens, oceanensis*) and the *blepotis* group, and also between the *fuliginosus* subgroup (*fuliginosus*) and the *blepotis* group. These statements appear at least superficially to contain a contradiction. A comparison of Maeda's distribution maps (figs 34, 35) for these taxa shows that (excluding *magnater* and *macrodens,* discussed below) each replaces another in characteristic fashion across the region and that none is sympatric although *schreibersii* and *fuliginosus* are nearly so in Afghanistan. Maeda himself (p. 28) stated that according to his conclusions 'In many miniopterine bats, the species belonging to the same group are usually allopatric in distribution'.

The interpretation by Maeda produces a number of curious distributional anomalies. Thus *oceanensis* is said to occur in Australia, the Solomon Islands and tentatively in Burma and Yunnan. However, the specimen from Burma (BM(NH) 67.2323) has a molar width (m^3–m^3) of 6·8 and so, from his key, falls into the *fuliginosus, blepotis* or *schreibersii* groups, while its toothrow (i^1–m^3) length of 7·3 and mastoid width of 8·7 take it to the *fuliginosus* subgroup or the *blepotis* group. The length of the forearm is 48·0 and the greatest skull length 15·4, the condylobasal length 15·2: these values take it further in the key to *fuliginosus.* Specimens from Yunnan (BM(NH) 12.7.25.4–5) have damaged skulls from which only the palatal measurements can be drawn but these (Table 13) agree closely with those of *macrodens* from Thailand and Koh Lak Island.

A further anomaly is to be found in the distribution of *eschscholtzii,* as it is proposed by Maeda. According to this author, it occurs in the Philippines whence it was originally named, in northern and South Australia where in northern Australia according to Maeda it displaces the name *orianae* Thomas, 1922, and on San Christobal Island in the Solomon Islands. The South Australian record is drawn from Leche (1884) who originally identified the material as *M. schreibersii blepotis.* The remaining Australian examples were originally referred to *M. s. orianae*: those from San Christobal to *M. s. blepotis* by Hill (1971*a*). However, the Australian examples referred initially to *orianae* do not always meet the criteria laid down in Maeda's key for *eschscholtzii,* some (BM(NH) 22.10.8.2–3, 29.1.9.1) keying more appropriately to *blepotis* and another (BM(NH) 29.1.9.3) producing some ratios more appropriate to his parameters for *fuliginosus.* Similar considerations apply to specimens (BM(NH) 54.901–903) from Rennell Island, from San Christobal Island (BM(NH) 67.1882–1883, 67.1885–1888) and one (BM(NH) 91.8.20.2) from Bugota Island, all in the Solomon Islands.

A condition such as this might be expected within the distribution of a widespread polytypic species with populations scattered over numerous islands of different size: some populations at least, even on widely distant islands, might be expected to resemble each other in some features of size and proportion. A further point is that of the San Christobal series (BM(NH) 67.1882–1888) identified formerly as *blepotis,* one example BM(NH) 67.1884) is determined by Maeda as *oceanensis,* while the remainder are referred to *eschscholtzii.* This is apparently because this specimen has a slightly wider palate (m^3–m^3 7·0) than the others (m^3–m^3 6·6–6·9) and thus keys to the *magnater* subgroup of Maeda (and hence to *oceanensis*) rather than to the *schreibersii, fuliginosus* or *blepotis* agglomerations, as do the remainder of the series.

In Amboina Maeda (1982) records *blepotis* and *oceanensis* sympatrically. However, members of the one series of specimens from Amboina Island in the British Museum (Natural History) (BM(NH) 10.7.24.24–26) have very slightly wider palates and are very slightly larger (Table 12) than specimens from the Kei Islands (BM(NH) 10.3.1.30, 10.3.1.70–71, 74, 94, 95) that otherwise they closely resemble. Consequently like BM(NH) 67.1884 from San Christobal they key to *oceanensis* while examples from the Kei Islands are taken to *blepotis,* yet as can be seen (Table 12) actual differences are very small. The Amboina specimens that Maeda refers to *blepotis* are in the Rijksmuseum van Natuurlijke Historie: they include one skull (his population 47, p. 92). According to his table of measurements (p. 127) this skull has a mastoid width of 7·0: it should therefore key out to his *magnater* subgroup (including *oceanensis*) rather than to *blepotis* to which he refers it.

I am led to the conclusion that *oceanensis* from Amboina, New Guinea, the Solomon Islands and eastern Australia should be considered a subspecies of *M. schreibersii* as here understood, rather than be associated with *M. magnater.* Those from Timor reported as *magnater* by Goodwin (1979) seem on size to be more properly referred to *M. s. oceanensis*: all are linked to the smaller, more westerly populations by those from the Kei Islands. The collections of the British Museum (Natural History) contain only a single example (BM(NH) 78.1.21.6) of *M. schreibersii* from New Guinea: Maeda (1982) refers it to *oceanensis* and records no other New Guinea specimen. However, I have examined two further examples (♂, ♀ BBM 55803, 55893) from the Bernice P. Bishop Museum, Honolulu, that also come from New Guinea. These are from Danowaria Cave, near Fak Fak, Fak Fak District, West Irian, at 25 m.

In view of the various considerations advanced above, I have retained the view that all of these medium-sized *Miniopterus* in Indo-Australia (excluding *magnater* and *macrodens*) form a polytypic species extending from Afghanistan to Japan, the Philippine Islands, the Solomon Islands and Australia. If allied to *schreibersii* of Eurasia then it extends westward into western Europe and into Africa: there seems at present no reason to consider the Asiatic and Indo-Australian populations distinct from *schreibersii* unless for example extensive sympatry can be demonstrated in Afghanistan where *M. s. pallidus* is found at Kandahar and *M. s. fuliginosus* at Jalalabad. In eastern Asia and in the Indo-Australian region this species

occurs from Japan (*japoniae* Thomas, 1906*b*) and northeastern China (*chinensis* Thomas, 1908*a*) to southern China and Vietnam (*parvipes* Allen, 1923), India and Sri Lanka (*fuliginosus* (Hodgson, 1835)), the Philippine Islands (*eschscholtzii* (Waterhouse, 1845)), Malaya and Sumatra east to Sulawesi and Java (*blepotis* (Temminck, 1840)), the Molucca Islands, New Guinea, the Solomon Islands and eastern Australia (*oceanensis* Maeda, 1982), and in northern Australia (*orianae* Thomas, 1922*c*). Maeda (1982) associated *oceanensis* with *M. magnater* but as already pointed out specimens referable to this form seem clearly on comparison to represent the smaller and not the larger of the two similar sympatric species although they are often rather larger than most of *M. schreibersii*. No specimens from Thailand have been examined. *Miniopterus haradai* Maeda, 1982, from the southern part of the country, however, is very close in size (Table 12) to specimens referred to *M. schreibersii* from Vietnam and Malaya and may well be its local representative. For the present I would consider it to be a subspecies of *M. schreibersii*.

Miniopterus magnater magnater Sanborn, 1931

Miniopterus schreibersii magnater Sanborn, 1931 : 26. Marienberg, 40 miles up Sepik R, Papua New Guinea.

Specimens examined. Papua New Guinea: ♂ BM(NH) 78.893 No further locality (in alcohol; coll. P. A. Morris); 2 ♂♂, 8 ♀♀ BM(NH) 80.658–667 Mt Kainoi, Wau, Morobe, 7° 31′ S, 146° 43′ E; 2 ♂♂, 2 ♀♀ BM(NH) 82.153–156 Cave at Avi, Mt Hagen (all in alcohol; coll. B. H. Gaskell, 'Operation Drake').

Remarks. These specimens agree with *M. m. magnater* as it is represented by the limited sample hitherto in the collections of the British Museum (Natural History).

Discussion. The status of this species has been briefly discussed above. It is distinguished from *M. schreibersii* by its generally longer forearm, larger skull, wider braincase and wider palate. Maeda (1982) defined a *magnater* subgroup in some detail, but in including *oceanensis* removed the basis of size characters in the definition of *magnater*, this newly recognised taxon being little larger than other Indo-Australian specimens of *M. schreibersii* as here understood but having the palate very slightly widened. It is based on specimens formerly allocated to *M. schreibersii* to which it is here allocated as a subspecies.

Specimens from localities from Hong Kong to Sumatra and Java have been briefly mentioned under *M. schreibersii blepotis* to which they were once referred. With the exception of some of the Thai and Sumatran examples they have been allocated to *macrodens* by Maeda (1982) when describing that form. In detail these come from Hong Kong (BM(NH) 65.1019, Old Mine, Silver Mine Bay), Burma (BM(NH) 32.11.1.3, Nam Tisang), Thailand (BM(NH) 79.1425–1426, no further locality; (BM(NH) 17.2.6.3, Koh Lak Island, off southeastern Thailand), Malaya (BM(NH) 67.217, Pine Tree Hill, Fraser's Hill, Pahang), Sumatra (BM(NH) 0.8.2.11–14, Balighe) and Java (BM(NH) 9.1.5.460–461, Soekaboemi, Preanger)[1]. The majority is male and all are fully adult or even old.

These specimens agree closely in structure and size (Table 13) with *M. magnater* from New Guinea. According to Maeda (1982) *M. macrodens* differs from *magnater* in shorter condylobasal length, shorter upper toothrow and narrower palate. A study of Maeda's measurements shows that while *macrodens* is generally smaller in these respects than *magnater*, the largest of the former overlaps the smallest of the latter, a circumstance apparent in the specimens in London. Indeed, in some respects one Sumatran example of *macrodens* exceeds *magnater* from New Guinea, yet in others falls at the lowest part of the range of the New Guinea material. For this reason I consider *macrodens* Maeda, 1982 a subspecies of *M. magnater*, distributed from Hong Kong and Burma at least to Sumatra and Java. Maeda (1982) refers specimens without skulls from Amboina to *macrodens* but their forearm length (populations 43, 45, pp. 110, 111) are compatible either with this form or with *magnater*: specimens from Mount Flinders, South Australia, also referred to *macrodens*

[1]See Addendum, p. 208.

by Maeda (population 81, pp. 114, 134) also have forearms of a similar length but the sole skull measured agrees with *macrodens*.

Miniopterus tristis celebensis Peterson, 1981

Miniopterus tristis celebensis Peterson, 1981*b* : 841. Luwu, Wawondula, Sulawesi, 02° 38′ S, 121° 21′ E.

SPECIMENS EXAMINED. C Sulawesi: ♂♂ BM(NH) 82.142–143 R Ranu, 1° 51′ S, 121° 30′ E (in alcohol, skulls extracted; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. These specimens clearly support Peterson's contention that the Sulawesian population of *M. tristis* is distinct from that of the Philippine Islands, from which Sulawesian examples may be distinguished by their larger size and especially by the greater length of the forearm and metacarpals. The examples recorded here bring the known total of specimens of *M. t. celebensis* to four. Measurements: (BM(NH) 82.142, 82.143): length of forearm 57·5, 57·1; III^m 54·2, 53·3; IV^m 51·9, 50·4; V^m 44·3, 44·0; length of tibia 24·1, 23·8; greatest length of skull 19·6, 19·7; condylobasal length 19·3, 19·2; condylocanine length 18·4, 18·4; least interorbital width 4·1, 4·3; zygomatic width 11·0, —; width of braincase 8·9, 9·0; mastoid width 10·0, 10·1; c^1–c^1 (alveoli) 6·0, 6·1; m^3–m^3 8·8, 8·8; c–m^3 8·3, 8·1; length of complete mandible from condyles 14·6, 14·7; length of right ramus from condyle 15·1, 15·1; c–m^3 8·8, 8·7.

DISCUSSION. Hill (1971*a*) in recording *M. tristis* from the Solomon Islands and the New Hebrides drew attention to the range of size variation exhibited by specimens referred to this species over its then total range to the Philippine Islands. At that time, the collections of the British Museum (Natural History) contained only the holotype of *M. tristis* sensu stricto, BM(NH) 55.12.26.266, and from New Guinea there were specimens available from no more than two widely separated localities. In view of the paucity of material this author left unresolved the questions posed by the range of variation, except to associate *robustior* Revilliod, 1914 from the Loyalty Islands with *tristis* as a distinct species rather than with *M. australis* as a subspecies as it was described and had been considered hitherto in the literature. Since then two widely divergent views of the classification of this group of bats have emerged which although in agreement in accepting *M. robustior* as a distinct species divide bats formerly regarded as *M. tristis* in different ways. Each of these treatments is based to a considerable extent on the collections of the British Museum (Natural History).

Peterson (1981*b*) recognised *M. tristis* in the Philippine Islands (*M. t. tristis* (Waterhouse, 1845)) and Sulawesi (*M. t. celebensis* Peterson, 1981*b*), with a second species, *M. propitristis,* from western New Guinea (*M. p. grandis* Peterson, 1981*b*), eastern New Guinea (*M. p. propitristis* Peterson, 1981*b*) and from the Bismarck Archipelago, the Solomon Islands and the New Hebrides (*M. p. insularis* Peterson, 1981*b*). This author had available a good series of specimens from the Philippines and based his conclusions in part on a multivariate analysis of a number of characters. Particular morphological features indicated as separating *propitristis* from *tristis* include a greater degree of development of the sagittal crest over the rear of the cranium, lower, flatter rostral profile, greater constriction, or less inflation, of the posterior part of the braincase, a less conspicuous bulging of the supraoccipital (not the supraorbital as stated by Peterson, p. 833) behind the lambdoidal crests, and a wider palate in relation to the length of the toothrow.

Some of these features are not always especially effective in diagnosis. The sagittal crest, for example is little different in the Sulawesian specimens (*tristis*) recorded here than in some of those (*propitristis*) from western New Guinea, while the rostrum of some specimens from western New Guinea is more steeply elevated as in Sulawesian specimens. The constriction of the posterior part of the braincase varies slightly in New Guinea specimens and in a number is little different from those from Sulawesi and although the posterior bulge of the

supraoccipital is more conspicuous in Philippine and Sulawesian specimens than in those from western New Guinea, this condition is approached or equalled by others from the eastern part of that island. As Peterson (fig. 7) shows, the width of the rear palate in relation to the length of the toothrow provides a relatively useful diagnostic character, with little overlap between specimens referred to *tristis* and those referred to *propitristis*. However, the Sulawesian population seems equally referable on this feature to *propitristis* as to *tristis*: indeed, with the addition of the specimens recorded here it could be regarded as corresponding quite as closely to the *propitristis* grouping as it does to the Philippine examples.

Maeda (1982), on the other hand, regarded the Philippine population and those from both western and eastern New Guinea and that on New Britain as referable to one species, *M. tristis,* without subspecific separation. He removed the populations on the Solomon Islands and the New Hebrides to a distinct species, *M. melanesiensis,* which he described as new on account of its smaller size, the same grounds as those used by Peterson (1981*b*) in dividing *M. propitristis insularis* from the New Guinea form *M. p. propitristis,* a feature also noted by Hill (1971*a*). Maeda indicated in a footnote (p. 47) that *melanesiensis* is synonymous with *M. p. insularis,* the paper by Peterson being unavailable when his study was in preparation.

Of these treatments that by Peterson (1981*b*) seems the more satisfactory. Maeda (1982) examined only a single Philippine specimen and none from Sulawesi: it is apparent from the tabulated measurements of Hill (1971*a*) and Peterson (1981*b*) that a good case can be made for clinal variation among the populations from eastern New Guinea to the New Hebrides, and both of these authors considered them conspecific. At the same time, their separation from the Sulawesian and Philippine populations as a distinct species seems less strongly based than Peterson (1981) implies. The morphological characters that he cites are not wholly satisfactory and while they may be diagnostic between populations are not always so when these populations are grouped in the way that Peterson suggested. Although in palatal shape the two proposed species seem more definitely separable, there are indications that the Sulawesian population may not fully conform to the criteria set by Peterson for *tristis.* The representation remains small or limited in some instances: the Sulawesian population is known from no more than four specimens, that from western New Guinea from one locality only, and the population in eastern New Guinea only from three locations. Moreover, Koopman (1982) considered only one species involved after examining the characters used by Peterson in relation to specimens in the American Museum of Natural History. In these circumstances I too prefer to regard all as subspecies of *M. tristis,* i.e. *M. t. tristis* (Philippine Islands), *M. t. celebensis* (Sulawesi), *M. t. grandis* (W New Guinea), *M. t. propitristis* (E New Guinea) and *M. t. insularis* (with synonym *M. melanesiensis* Maeda, 1982 from San Christobal Island, Solomon Islands) (Bismarck Archipelago to the New Hebrides).

Miniopterus tristis insularis Peterson, 1981

Miniopterus propitristis insularis Peterson, 1981*b* : 838. Kagilakulaku Cave, Hutuna, Rennell Island, Solomon Islands 11° 45′ S, 160° 15′ E.
Miniopterus melanesiensis Maeda, 1982 : 19. St. (=San) Christobal Island, Solomon Islands.

Specimens examined. New Hebrides: 3 ♂♂, 3 ♀♀ BM(NH) 73.1547–1552 Hog Harbour, Espiritu Santo I, 150 ft (in alcohol, BM(NH) 73.1548, 73.1552 without skulls; coll. Earl of Cranbrook, Royal Society Expedition to the New Hebrides, 1971).

Remarks. Specimens from Hog Harbour reported by Baker & Bird (1936) as *M. schreibersii* were referred to *M. tristis* by Hill (1971*a*), this taxon being later divided (above) by Peterson (1981*b*). Others from St. Matthias Island in the Bismarck Archipelago were referred to

insularis by Peterson (1981*b*) but to *M. oceanensis* (=*M. schreibersii oceanensis* as here understood) by Maeda (1982). Further examination establishes them as belonging to *insularis.*

Discussion. Maeda (1982) has described *Miniopterus bismarckensis* from Manus I, Bismarck Archipelago as a new species in the *tristis* group, basing it on a series of five specimens (BM(NH) 14.4.1.11, 11*–14) in the collections of the British Museum (Natural History). The series appears as population 62 of Maeda (pp. 112, 130): although not noted as such by this author, two (BM(NH) 14.4.1.12,14) are not fully adult. I am unable to agree with Maeda that the length of the tibia in this series measures 16·5–17·5 (p. 112): in the two young examples the tibia measures 17·4 and 16·9 respectively, in the three adults 19·0 (BM(NH) 14.4.1.11.11), 18·7 (BM(NH) 14.4.1.11*) and 18·8 (BM(NH) 14.4.1.13). Forearm lengths in these adults are 46·4, 45·0 and 44·4 respectively. Moreover, I fail totally to understand whence Maeda obtained the total length for five skulls for this form (p. 130). The three adults consist of the rostrum and mandible only, the whole of the cranium beyond the frontal region missing. In BM(NH) 14.4.1.14 the basal part of the cranium and its posteriormost part except the occiput is lost and the best value that can be obtained for total length is 15·1 while in BM(NH) 14.4.1.12 the braincase has been damaged but the rear of the cranium survives. It is thus the only more or less complete example but even so the premaxillae have been damaged and the best value that can be obtained for total length is 16·3. It is difficult to reconcile these facts with Maeda's published value for total length of skull of 15·8–17·3 with a mean of 16·84 in the five examples. Other relevant values for BM(NH) 14.4.1.12 are condylobasal length 16·1, condylocanine length 15·6, least interorbital width 3·6, width of braincase 8·0, mastoid width 8·8 (these last two taken by eyepiece micrometer, the first of these by extrapolation, one side of cranium damaged), m^3–m^3 c. 7·1 (left m^3 missing), c–m^3 7·0, c–m_3 7·3. Of the remaining specimens BM(NH) 14.4.1.11 has lost both rear upper molars and cannot be used for palatal measurements, BM(NH) 14.4.1.11* (the holotype of *bismarckensis*) has the left upper molar displaced but the distance m^3–m^3 can be determined, while BM(NH) 14.4.1.13 is palatally and dentally complete. Such palatal and dental measurements as can be obtained appear in Table 13.

Although Maeda placed *bismarckensis* in the *tristis* group, the dimensions of the one admittedly slightly young skull (BM(NH) 14.4.1.12) that provides enough measurements to satisfy the requirements of his key take this specimen quite emphatically not to the *tristis* group, but to the *fuliginosus, blepotis* or *schreibersii* groups, among which it then keys to the *magnater* subgroup, fitting best with *magnater* or *macrodens* but perfectly with neither. Peterson (1981*b*) also apparently allocated four of these five specimens to *M. propitristis insularis* (=*M. tristis insularis* as understood here) but they are small for this form as he defines it, a point confirmed by a specimen (BM(NH) 39.1407) from New Britain that undoubtedly represents *insularis* and also by a long series of *insularis* from New Ireland that I have been able to examine through the courtesy of Professor James D. Smith of California State University at Fullerton, California. In these the greatest length of skull varied from 17·3–18·0 in 38 examples, the condylobasal length from 16·7–17·5 in 40 specimens, m^3–m^3 from 7·3–8·1 in 40 examples, and c–m^3 from 7·1–7·6 in forty-one. Moreover, the values for m^3–m^3 and c–m^3 that can be established for the specimens from Manus fall considerably outside the limits of *M. t. insularis* in the scatter diagram (p. 836, fig. 7) provided by Peterson, although it appears that he has failed to plot the lowest values given for this form in Table 5 (p. 839). In the relative width of the palate to the length of the toothrow the specimens from Manus agree equally well with *M. magnater magnater* or *M. magnater macrodens.* So far as can be determined the sagittal crest in the specimens from Manus is low rather than well developed as in *insularis,* and the rostrum is less broadened than in that form. While it is difficult to be definitive with such limited material, I am not convinced that these specimens should be referred to the *tristis* group: it is possible that they represent a form allied to *M. magnater.* The point can only be resolved by further, complete specimens from Manus.

MURININAE

Murina suilla (Temminck, 1840)

Vespertilio suillus Temminck, 1840 : 224. Java.

SPECIMENS EXAMINED. Borneo: ♂ BM(NH) 82.548 Samusan Wildlife Sanctuary, between Cape Datu and Gunong Pueh, W Sarawak, c. 1° 55′–2° 00′ N, 109° 34′–109° 39′ E (in alcohol; coll. N. A. MacKenzie); ♂ BM(NH) 82.555 Path to South Hitam, Gomantong, Sabah (in alcohol; coll. C. M. Francis).

REMARKS. The few earlier records of *M. suilla* from Borneo are summarized by Medway (1965, 1977). Length of forearm (BM(NH) 82.548, 82.555) 31·4, 29·2.

Murina aurata Milne Edwards, 1872

Murina aurata Milne Edwards, 1872 : 250, pl. 37b, fig. 1, pl. 37c, fig. 2. Moupin, Szechwan, China.
(?) *Harpiocephalus feae* Thomas, 1891 : 884; 1892 : 926–927. Biapo, Karen Hills, Burma.

SPECIMENS EXAMINED. Nepal: ♂ BM(NH) 75.301 2 km E of Mukut, N of Dhaulagirui, 28° 50′ N, 83° 25′ E, 13,500 ft (skin, skull; coll. G. B. Corbet).

Thailand: ♂ BM(NH) 82.162 Doi Ithanon, Chom Thong, Chiangmai, c. 2550 m, 18° 35′ N, 98° 29′ E (in alcohol, skull extracted; coll. D. S. Melville).

REMARKS. These specimens agree closely with the detailed account of *M. aurata* by Maeda (1980) who also examined and listed BM(NH) 75.301. The species has not before been recorded from Thailand; it may be readily recognised by its small size (length of forearm (7) 28·5–32·0, condylobasal length (6) 12·3–13·1, c–m^3 (7) 4·3–4·6; values in part from Maeda, 1980) and distinctive coloration, the dorsal pelage basally brownish, the hairs with bright, lustrous yellow brown tips, the ventral surface blackish, overlaid with white or greyish white tipping. The upper surface of the forearm and thumb is sparsely covered with brown hairs and the dorsal surface of the uropatagium, the tibiae and feet with a moderate cover of longer, brownish or chestnut hairs. Externally it is very similar to *M. aenea* Hill, 1964 from Malaya but this species has a longer forearm (length (2) 33·7–35·0) and a much larger skull (condylobasal length (2) 15·2–15·9, c–m^3 (2) 5·8–5·9) that is nearer in size to that of *M. cyclotis* Dobson, 1872*b* and has bronze tipped pelage.

DISCUSSION. Ellerman & Morrison-Scott (1951) listed *feae* (Thomas, 1891) as a subspecies of *M. aurata* while Maeda (1980) tentatively synonymised the two but did not examine the holotype of *feae*, which is probably in the Museo Civico di Storia Naturale Giacomo Doria in Genoa. Certainly from the description *feae* is very like *aurata,* differing chiefly in the absence of any distinct fringe of hairs along the edge of the uropatagium and in its duller, more brownish coloration. Moreover, the holotype did not come from northern Burma as Maeda indicated, but from the Carin or Karen Hills, northeast of Toungoo, in the more southerly part of the country. Indeed, this location is not greatly distant from Doi Ithanon, whence *aurata* is here recorded. In the restricted sense of Maeda (1980) who excluded specimens from northeastern Asia and Japan as a distinct species only twelve examples (including the holotype of *feae*) of *M. aurata* have been reported, their range extending through the montane parts of northern India, Nepal, Burma and Thailand to Szechuan and Yunnan.

Murina tubinaris (Scully, 1881)

Harpiocephalus tubinaris Scully, 1881 : 200, fig. 1. Gilgit, Kashmir.

SPECIMEN EXAMINED. Thailand: ♂ BM(NH) 82.163 Doi Inthanon, Chom Thong, Chiangmai, c. 1650 m, 18° 35′ N, 98° 29′ E (in alcohol, skull extracted; coll. D. S. Melville).

REMARKS. This is the first of *M. tubinaris* to be reported from Thailand. It agrees closely with specimens of this species from northeastern India and northern Burma and is greyish brown dorsally and greyish white ventrally, the upper surface of the forearms, tail, legs and uropatagium sparsely or only moderately clothed with greyish brown hairs. The anterior premolars (pm^3_2) are considerably reduced to one half or less than one half the crown area of the second premolars (pm^4_4) and to about two thirds of their height. The species differs from *M. cyclotis* and from *M. huttonii* (Peters, 1872*a*) in its chiefly greyish and not brownish dorsal colour, in more convergent upper toothrows, more reduced anterior premolars and in less massive molar teeth. Although similar in length of forearm to *M. aurata* it has a slightly larger skull (length of forearm (19) 29·0–32·0; condylobasal length (12) 13·3–14·2, c–m^3 (15) 4·8–5·2).

DISCUSSION. Hill (1962) recorded *M. tubinaris* from northern Burma, considering it a species distinct from *M. huttonii* with which it had been associated as a subspecies by Ellerman & Morrison-Scott (1951), the same author later (1964) describing and discussing it in more detail. Its discovery in the northern part of Thailand is not unexpected: it occurs otherwise from Kashmir through northern India and Burma apparently to Vietnam.

Murina cyclotis cyclotis Dobson, 1872

Murina cyclotis Dobson, 1872*b* : 210; 1873*c* : 206. Darjeeling, northeastern India.

SPECIMENS EXAMINED. Thailand: ♂ BM(NH) 82.164 Doi Inthanon, Chom Thong, Chiangmai, c. 1650 m, 18° 35′ N, 98° 29′ E (in alcohol); ♂ BM(NH) 82.165 Doi Pha Hom Pok, c. 1650 m (in alcohol, skull extracted; both coll. D. S. Melville).

REMARKS. As with the earlier example of *M. cyclotis* reported from Chiangmai by Hill & Thonglongya (1972) these specimens agree closely with the definition of the species by Hill (1964) and with examples in the British Museum (Natural History) from Burma. Dorsally *M. cyclotis* is generally some shade of rufous brown or ferrugineous, the ventral surface predominantly greyish white: the forearms, tail, tibiae, feet and uropatagium have a dense clothing of short, golden brown hairs on the upper surface. Young specimens are darker and browner. Coloration apart, the nominate subspecies is larger cranially (length of forearm (9) 30·2–34·8, condylobasal length (8) 14·7–15·8, c–m^3 (9) 5·0–5·7) than either *M. aurata* or *M. tubinaris*: a yet larger subspecies *M. c. peninsularis* Hill, 1964 occurs in the Malay Peninsula and in Borneo (vide infra) (length of forearm (9) 33·7–38·8, condylobasal length (9) 15·4–16·9, c–m^3 (9) 5·5–6·2). Dentally, *M. cyclotis* may be distinguished by the lack of reduction of the anterior upper premolar (pm^2) which in crown area is equal to three quarters or more of the crown area of the second upper premolar (pm^4), and by the reduction of the posterior triangles or talonids of its molar teeth, the paracones and protocones of the first (m^1) and second (m^2) upper molars being slightly reduced, the hypoconids and entoconids of the corresponding lower teeth very much more so, sometimes scarcely evident, and separated from the protoconids and metaconids only by a very narrow trough.

DISCUSSION. Four species of *Murina* have now been reported from Thailand, namely *M. aurata, M. tubinaris, M. cyclotis* and *M. huttonii* (Peters, 1872*a*), the last being reported from Chiangmai by Hill (1975) and Lekagul & McNeely (1977). This rather larger (length of forearm (11) 33·2–37·0, condylobasal length (10) 15·3–16·7, c–m^3 (11) 5·8–6·1) species is more brownish than *M. tubinaris* and like *M. cyclotis* does not have markedly convergent upper toothrows. The anterior upper premolar (pm^2) is a little more reduced than in the latter species, the tooth one half to two thirds the crown area of the second upper premolar (pm^4), while the hypoconids and entoconids of the first and second (m_{1-2}) lower molars are well developed and separated from the protoconids and metaconids by a comparatively wide trough.

Murina cyclotis peninsularis Hill, 1964

Murina cyclotis peninsularis Hill, 1964: 55. Ulu Chemperoh, near Janda Baik, Bentong District, Pahang, Malaya, c. 3° 18′ N, 101° 50′ E, 2000 ft.

SPECIMENS EXAMINED. Borneo: ♂ BM(NH) 78.1543 Melinau R, Gunung Mulu National Park, Sarawak (in alcohol, skull extracted; coll. D. R. Wells, Royal Geographical Society Expedition to Gunung Mulu, ♂ BM(NH) 82.556 Sepilok Forest Reserve, Sabah (in alcohol, skull extracted; coll: C. M. Francis).

REMARKS. Only *M. suilla* among tube-nosed bats has been reported until now from Borneo, *M. cyclotis* being known hitherto from the mainland of southeastern Asia and from single specimens from the islands of Hainan off southeastern China and Mindanao in the Philippine Islands. These Bornean specimens agree closely with *M. c. peninsularis* from Malaya, to which they are referred.

Measurements (BM(NH) 78.1543, 82.556), with those of seven Malayan examples in parentheses: length of forearm 37·0, 35·6 (33·7–38·8); greatest length of skull 18·8, 18·4 (17·4–18·9); condylobasal length 16·9, 16·8 (15·4–16·7); length orbit–gnathion 4·6, 4·5 (4·2–4·5); palatal length 9·3, 9·2 (8·2–9·3); rostral width at lachrymals 6·3, 6·3 (5·5–6·0); least interorbital width 4·3, 4·5 (4·3–4·6); zygomatic width 11·3, 10·9 (9·9–10·9); width of braincase 8·3, 8·3 (7·7–8·2); height of braincase 7·1, 6·8 (6·6–6·9); mastoid width 9·4, 9·2 (8·3–9·1); c^1–c^1 (cingula) 5·3, 5·2 (4·5–5·2), (alveoli) 5·1, 5·1 (4·5–5·1); m^3–m^3 6·1, 6·0 (5·6–6·0); c–m^3 6·1, 6·0 (5·5–6·2); length complete mandible from condyles 12·3, 12·0 (10·9–12·1); length right ramus from condyle 12·8, 12·5 (11·2–12·7); c–m_3 6·4, 6·2 (6·0–6·4).

DISCUSSION. There exist now apparently nine known examples of this large subspecies: in addition to those recorded here from Borneo and those reported from Malaya by Hill (1964, 1972) the collections of the British Museum (Natural History) also include two further specimens from Malaya, BM(NH) 73.630–631, both male, from Telok Chempedak, Pahang.

Murina sp.

SPECIMEN EXAMINED. Molucca Islands: ♀ BM(NH) 82.144 (juv.) Latuhalat, Amboina I (in alcohol; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. It is not possible to attempt any further identification of this juvenile example in which the milk dentition is not yet completely lost and the adult dentition only partially erupted.

DISCUSSION. Records of tube-nosed bats of the genus *Murina* from the region east of Borneo are few (Van Deusen, 1961). The genus has yet to be reported from Sulawesi itself, although it has been recorded from the nearby island of Peleng by Tate (1941*e*): it is also known from the Lesser Sunda Islands (Flores, Sumbawa), from the Moluccas (Ceram, Buru, Goram), New Guinea and the Bismarck Archipelago (Ruk (=Umboi) I). According to Van Deusen (1961) the specimens forming the basis of these records total fourteen: more recently, Richards (1981) and Richards *et al.* (1982) have reported a further example of the genus from Queensland, Australia. The specimen recorded here is the first of *Murina* to be recorded from Amboina, where clearly it might be expected to occur.

Three taxa have been named from the region: *florium* Thomas, 1908*b* from Flores, *lanosa* Thomas, 1910*b* from Ceram, and *toxopei* (=*toxopeusi*) Thomas, 1923 from Buru. Laurie & Hill (1954) considered *lanosa* and *toxopeusi* conspecific with *florium*, regarding specimens from Sumbawa originally recorded by Mertens (1936) as *M. suilla* more probably representative of *M. f. florium*. Tate (1941*e*) found the specimens from Peleng Island conformed closely to *M. florium*, while Hill (in Van Deusen, 1961) thought the example from Ruk I, originally recorded by Thomas (1914*a*) without specific identification, to be

close to *toxopeusi*. Van Deusen (1961) considered that an evaluation of the characters on which these taxa were based seemed to indicate that only one good species existed east of Wallace's Line, but through lack of comparative material did not attempt to apply a specific name to the specimen that he recorded from New Guinea. Richards *et al.* (1982) referred the specimen from Queensland to *M. florium*.

A further examination of the limited material in the collection of the British Museum (Natural History) supports the view that only one species is involved, *florium, lanosa* and *toxopeusi* being almost certainly conspecific. All are larger, especially cranially, than *M. suilla* from Java and its closely related congeners *balstoni* Thomas, 1908*b*, also from Java, and *canescens* Thomas, 1923*a*, from Nias Island, off the west coast of Sumatra, both very similar to *suilla* and possibly no more than subspecifically different from it. Only the holotypes of *florium* (BM(NH)63.12.26.14) and *toxopeusi* (BM(NH)23.1.2.27) are available, with the holotype (BM(NH) 10.3.4.24) and one other example (BM(NH) 7.1.1.482) of *lanosa* from Ceram, together with a specimen (BM(NH) 10.3.4.115) from Goram referred to *lanosa* by Laurie & Hill (1954) and the specimen (BM(NH) 14.4.1.33) recorded from Ruk Island by Thomas (1914*a*). Removal of the skull from the specimen from Goram confirms that it represents *lanosa* rather than *toxopeusi*. The example from Ruk, however, has a shallow median

Table 14 Measurements of *Murina* from east of Wallace's Line.

	M. florium florium Holotype BM(NH) 63.12.26.14 Flores I	*M. florium lanosa* Holotype ♀ BM(NH) 10.3.4.24 Ceram I	*M. florium lanosa* BM(NH) 7.1.1.482 Ceram I	*M. florium lanosa* BM(NH) 10.3.4.115 Goram I	*M. florium toxopeusi* Holotype ♂ BM(NH) 23.1.2.27 Buru I	*M. ? florium* ♀ BM(NH) 14.4.1.33 Ruk I, Bismarck Is	*M. ? florium* Van Deusen (1961) New Guinea	*M. florium* Richards *et al.* (1982) Queensland, Australia
Length of forearm	34·8	36·9	36·4	36·9	34·4	35·4	35	35·7
Greatest length of skull	—	16·7	—	17·3	16·7	—	15·4	16·9
Condylobasal length	—	15·5	—	15·7	15·3	—		15·8
Condylocanine length	—	14·8	—	15·1	14·7	—		
Palatal length	—	7·2	—	7·0	7·1	—		
Width across anteorbital foramina	4·5	4·3	4·5	4·5	4·2	4·3		
Least interorbital width	4·2	4·5	4·3	4·5	4·2	4·4	4·3	4·6
Zygomatic width	—	9·2	—	9·5	9·3	—	8·9	10·2
Width of braincase	—	7·9	—	7·9	7·6	—	7·8	8·1
Mastoid width	—	8·2	—	8·4	8·0	—		
c^1–c^1 (alveoli)	3·8	3·9	4·0	4·0	3·8	4·0		
m^3–m^3	5·6	5·4	5·6	5·6	5·5	5·7		6·1
c–m^3	5·3	5·5	5·6	5·6	5·5	5·6	5·3	5·8
Length complete mandible from condyles	10·8	11·3	11·1	11·2	11·0	11·3		
Length right ramus from condyle	11·1	11·4	11·6	11·5	11·4	11·6		
c–m_3	6·0	6·1	6·2	6·2	6·1	6·3		6·2

rostral sulcus and its anterior upper premolar (pm^2) is longitudinally compressed and rather short, in these respects agreeing more closely with the holotype of *toxopeusi* than with *lanosa*. Although the Goram specimen has a slightly shallower sulcus than the examples of *lanosa* from Ceram, its pm^2 is less compressed than in the specimen from Ruk. These specimens, with the exception of the skull of the specimen from Goram, were first examined in 1961 at the instigation of the late Mr H. M. van Deusen of the American Museum of Natural History.

KERIVOULINAE

Kerivoula hardwickei hardwickei (Horsfield, 1824)

Vespertilio hardwickii Horsfield, 1824 (unpaginated). Java.

SPECIMENS EXAMINED. C Sulawesi: ♂♂ BM(NH) 82.145–146 R Ranu, 1° 51′ S, 121° 30′ E (in alcohol, skulls extracted; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. The larger (BM(NH) 82.146) of these examples tends in some respects to bridge the slight disparity in certain elements of size noted by Hill (1965) between specimens of *K. h. hardwickei* from more easterly localities (Philippine Islands, Borneo and Sulawesi) and those from more westerly locations (Java, Sumatra and Malaya). Measurements (BM(NH) 82.145, 82.146): length of forearm 31·7, 33·1; greatest length of skull 12·7, 13·6; condylobasal length 12·3, 12·9; condylocanine length 11·9, 12·6; least interorbital width 3·1, 3·3; zygomatic width 7·7, 8·0; width of braincase 6·7, 6·7; depth of braincase 5·5, 5·7; mastoid width 7·0, 7·3; c^1–c^1 (alveoli) 3·3, 3·3; m^3–m^3 4·9, 5·2; c–m^3 5·1, 5·4; length complete mandible from condyle 9·0, 9·6; length right ramus from condyle 9·2, 9·8; c–m^3 5·4, 5·7.

Kerivoula papillosa (?) malayana Chasen, 1940

Kerivoula papillosa malayana Chasen, 1940 : 55. Ginting Bedai, Selangor–Pahang boundary, Malaya, 2300 ft.

SPECIMEN EXAMINED. C Sulawesi: ♂ BM(NH) 82.147 R Ranu, 1° 51′ S, 121° 30′ E (in alcohol, skull extracted; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. This is the first of *K. papillosa* to be recorded from Sulawesi, the species being known hitherto from northeastern India to Sumatra, Borneo and Java. It agrees closely with *K. p. malayana*, reported hitherto as far east as Borneo. The collections of the British Museum (Natural History) do not include specimens of *K. p. papillosa* (Temminck, 1840) from Java: according to Tate (1941*e*), Bornean specimens agree in all essential respects with the type from Java but Chasen (1940) remarked that the few skins that he had seen from Java were rather greyer than those that he referred to *malayana,* with which he included Bornean examples. Chasen noted further that the skulls of Javan specimens are smaller than those of Malayan and Bornean examples, with a maximum length of about 17 but Tate gives measurements of a 'cotype' in the Rijksmuseum van Natuurlijke Historie, Leiden that suggest that this may not be so.

Measurements of the Sulawesian specimen: length of forearm 44·9; greatest length of skull 18·0; condylobasal length 16·5; condylocanine length 16·4; least interorbital width 3·6; zygomatic width 11·5; width of braincase 8·4; depth of braincase 7·3; mastoid width 9·1; c^1–c^1 (alveoli) 4·6; width inside m^1–m^1 3·1; m^3–m^3 6·6; c–m^3 7·4; m^{1-3} 3·9; length complete mandible from condyle 12·6; length right ramus from condyle 13·0, c–m_3 7·9.

Kerivoula muscina Tate, 1941

Kerivoula muscina Tate, 1941*e* : 586. Lake Daviumbu, 6 miles above mouth of Strickland R, middle Fly R, Western Division, Papua, c. 20 m.

SPECIMEN EXAMINED. Papua New Guinea: ♂ BM(NH) 80.668 Buso, Morobe, 7° 17′ S, 147° 08′ E (in alcohol, skull extracted; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. In size, cranial architecture and dentition this specimen agrees closely with the descriptions of *K. muscina* by Tate (1941*e*) and Hill (1965). Measurements: length of forearm 33·0; greatest length of skull 13·5; condylobasal length —; condylocanine length —; least interorbital width 3·2; zygomatic width —; width of braincase 6·8; mastoid width 7·2; c^1–c^1 (alveoli) 3·2; m^3–m^3 5·0; width palato-pterygoid extension 1·7; width of cochleae 2·4; width apart of cochleae 1·3; c–m^3 5·5; m^{1-3} 2·7; length complete mandible from condyles 9·8; length right ramus from condyle 10·0; c–m_3 5·9.

MOLOSSIDAE

Tadarida (Chaerephon) plicata (Buchannan, 1800)

Vespertilio plicatus Buchanan, 1800 : 261, pl. 13. Bengal.

SPECIMENS EXAMINED. Sex indet. BM(NH) 78.2509 Lubang Rusa, Gunong Mulu National Park, 4th Division, Sarawak (mummified, skull; coll. Earl of Cranbrook, Royal Geographical Society Expedition to Mount Mulu); 2♂♂, ♀ (all yg.) BM(NH) 931–933 Mouth of Deer Cave, Gunung Mulu National Park (in alcohol; coll. C. H. Fry, Royal Geographical Society Expedition to Mount Mulu); 4 ♂♂ (3 yg.), 2 ♀♀ (1. yg.) BM(NH) 956–961 Deer Cave (in alcohol; coll. P. Chapman, Royal Society Expedition to Mount Mulu); ♂, ♀ BM(NH) 79.1400–1401 Deer Cave (in alcohol; coll. S. Proctor, Royal Society Expedition to Mount Mulu); sex indet. BM(NH) 79.953–954 Madai Cave, Sabah (skeletal parts); ♂ Sabah Museum No. NH 95 Madai Cave (in alcohol) (all from Sabah Museum).

REMARKS. There are relatively few published records of *T. plicata* from Borneo. The species has been reported previously from Pengkalan Forest, 1st Division in Sarawak by Medway (1965) and in Sabah from Madai by Chasen (1931), Gomanton by Pryer (1884) and from Sapagaya by Davis (1962). Length of forearm in 6 adults 40·4–43·5.

DISCUSSION. Specimens from Borneo are usually referred to *T. p. plicata* (Hill, 1961*b*; Medway, 1965). As Davis (1962) pointed out, however, the forearm in Bornean specimens averages shorter than in those from Java (?*T. p. dilatata* Horsfield, 1822) and is also shorter on the average than in the nominate subspecies. In forearm length they approach the Philippine form *T. p. luzonus* Hollister, 1913 or the more doubtful *T. p. tenuis* (Horfield, 1822) from eastern Java, recognised by Chasen (1940), Tate (1941*c*) and Hill (1961*b*).

Tadarida (Chaerephon) jobensis jobensis (Miller, 1902)

Nyctinomus jobensis Miller, 1902 : 246. Ansus, Jobi I, Geelvinck Bay, West Irian.

SPECIMENS EXAMINED. Papua New Guinea: 9 ♂♂, 14 ♀♀BM(NH) 80.669–679, 80.681–692 Buso, Morobe, 7° 17′ S, 147° 08′ E (in alcohol; coll. B. H. Gaskell, 'Operation Drake').

REMARKS. These specimens with length of forearm (23) 43·3–47·9 confirm that in *T. j. jobensis* the forearm is rather shorter than in *T. j. colonicus* (Thomas, 1906*a*) from northern Australia which has a forearm length of (6) 47·0–52·2, but is generally longer than in *T. j. solomonis* (Troughton, 1931) from the Solomon Islands, for which the describer gave a forearm length of (200) 40·5–45.

Tadarida (Chaerephon) jobensis bregullae Felten, 1964

Tadarida jobensis bregullae Felten, 1964 : 9. Malo I, New Hebrides.

SPECIMENS EXAMINED. New Hebrides: ♀, ♂ BM(NH) 73.1553–1534 Tan Lensingo Cave, Abounatori Village, Malo I, 30 m; ♂♂ BM(NH) 73.1555–1568 Abounatori Village, 30 m (BM(NH) 73.1553–1566 in alcohol, 73.1567–1568 skins, skulls; obtained by the Earl of Cranbrook, Royal Society Expedition to the New Hebrides, 1971).

REMARKS. These are the first of *T. j. bregullae* to be reported since the subspecies was described. The length of the forearm in 15 fully adult examples ranges from 47·6–51·4, rather more widely than in the ten of the original specimens measured and reported by Felten. In forearm length the subspecies is similar to *T. j. colonicus* but according to the describer has a narrower skull, a contention supported by skulls from the present series.

Cranial measurements of BM(NH) 73.1567, 73.1568 with (in parentheses) those of 8 of *colonicus,* from Felten, (1964) who also included measurements made by Hill (1961*b*); condylobasal length 18·5, 18·4 (18·3–19·7); least interorbital width 4·1, 4·0 (4·0–4·4); zygomatic width 11·8, 11·4 (11·9–13·1); width of braincase 9·5, 9·3 (9·5–10·4); mastoid width 10·8, 10·7 (11·1–11·9); c^1–c^1 (alveoli) 5·4, 5·2 (5·2–6·1); m^3–m^3 (alveoli) 8·5, 8·3 (8·9–9·5); c–m^3 (crowns) 7·5, 7·5 (—), (alveoli) 7·2, 7·2 (7·3–7·7).

DISCUSSION. Freeman (1981) synonymised *T. j. bregullae* but whether into *T. j. jobensis, T. j. colonicus* or *T. j. solomonis* is not clear. Its various dimensional differences from these, however, suggest that at least for the present it should be retained.

Tadarida (Mormopterus) beccarii astrolabiensis (Meyer, 1899)

Nyctinomus astrolabiensis Meyer, 1899 : 19, pl. 10, figs. 19, 30, pl. 11, fig. 6. Bongu, Astrolabe Bay, West Irian.

SPECIMENS EXAMINED. Papua New Guinea: ♀♀ BM(NH) 80.680, 80.693, 80.695 Buso, Morobe, 7° 17′ S, 147° 08′ E (in alcohol, skulls of BM(NH) 80.693, 80.695 extracted; coll. B. H. Gaskell, 'Operation Drake').

Australia: ♀ BM(NH) 78.2708 Mount Wando, 36 miles SSW of Emerald, C Queensland, 23° 56′ S, 147° 46′ E (coll. G. Gordon & B. C. Lawrie); ♂ BM(NH) 78.2709 Barret's Lagoon, NE Queensland, 18° 03′ S, 145° 58′ E (coll. R. J. Grimes) (both in alcohol, skulls extracted; from F. R. Allison, through National Parks and Wildlife Service).

REMARKS. Relatively few specimens of *T. b. astrolabiensis* have been recorded: these agree closely with a small series (BM(NH) 11.11.11.18–20) in the British Museum (Natural History) from the Mimika River, West Irian. The nominate subspecies *T. b. beccarii* (Peters, 1881) from Amboina Island is represented in London by no more than three examples (BM(NH) 10.7.25.17–19) and has a slightly shorter and in some respects slightly narrower skull with a shorter toothrow than *T. b. astrolabiensis.*

Measurements of specimens from New Guinea, including the Mimika River series (BM(NH) 11.11.11.18–20) first measured by Hill (1961*b*), with (in parentheses) corresponding values for *T. b. beccarii* from Amboina (BM(NH) 10.7.25.17–19 in that order, skulls BM(NH) 10.7.25.18–19): length of forearm (6) 33·3–35·9 (33·4, 34·3, 34·9); greatest length of skull (5) 17·3–18·3 (16·6, 16·6); condylobasal length (5) 16·5–17·3 (16·0, 16·1); condylocanine length (5) 16·2–16·9 (15·7, 15·7); least interorbital width (5) 4·2–4·7 (4·2, 4·2); zygomatic width (2) 11·0, 11·7 (—, —); width of braincase (5) 8·0–8·5 (8·0, 8·1); mastoid width (5) 10·3–10·8 (9·7, —); c^1–c^1 (alveoli) (5) 4·5–5·0 (4·6, 4·2); m^3–m^3 (alveoli) (5) 7·7–8·2 (7·5, 7·3); c–m^3 (crowns) (5) 6·4–6·6 (5·9, 6·0), (alveoli) (5) 6·2–6·4 (5·8, 5·9); pm^4–m^3 (alveoli) (5) 4·7–4·9 (4·5, 4·6); length complete mandible from condyles (4) 11·9–12·6 (11·2, 11·5); length right ramus from condyle (4) 12·6–13·0 (11·7, 12·0); c–m_3 (crowns) (4) 6·8–7·0 (6·4, 6·4).

The species does not appear to have been formally reported hitherto from Queensland or indeed from Australia but F. R. Allison in Honacki *et al.* (1982) includes N Australia within its distribution. The two specimens reported here are nearer in size to *T. b. astrolabiensis* than to the nominate subspecies but have longer forearms and slightly more massive canine teeth. It seems possible that adequate series of specimens might permit the recognition of an Australian subspecies. Measurements BM(NH) 78.2708, 78.2709): length of forearm 37·9, 36·4; greatest length of skull 17·1, 18·1; condylobasal length 16·9, 17·9; condylocanine length 16·1, 17·1; least interorbital width 4·0, 4·5; zygomatic width —, —; width of braincase 8·2, 8·6; mastoid width —, 10·9; c^1–c^1 (alveoli) 6·2, 6·5; m^3–m^3 (alveoli) 7·3, 8·2; c–m^3 (crowns) 6·4, 6·7, (alveoli) 6·2, 6·5; pm^4–m^3 (alveoli) 4·8, 5·1; length of complete mandible from condyles 12·1, 12·9; length right ramus from condyle 12·8, 13·5; c–m_3 (crowns) 6·8, 7·2.

The small anterior upper premolar (pm^2) is absent from the left side of the jaw but present in the other side in BM(NH) 80.693, the opposite condition occurring in BM(NH) 80.695, while in BM(NH) 80.680 it is absent from both sides: it is present in both sides in the Australian examples. The absence of this tooth from one of the Amboina specimens (*T. b. beccarii*) and from two of those from the Mimika River (*T. b. astrolabiensis*) was noted by Hill (1961*b*).

Discussion. Freeman (1981) raised *Mormopterus* to generic rank. Certainly it is one of the most distinctive of the subgenera of *Tadarida,* its relatively delicate, angular ears of thin integument, with small antitragal lobe, and its finely wrinkled upper lip setting it apart from the other subgenera.

Tadarida sp.

Specimen examined. Papua New Guinea: Sex indet. BM(NH) 80.696 (nurseling). Buso, Morobe, 7° 17′ S, 147° 08′ E (in alcohol; coll. B. H. Gaskell, 'Operation Drake').

Otomops papuensis Lawrence, 1948

Otomops papuensis Lawrence, 1948 : 413. Vailala R (flows into Gulf of Papua about 15 miles W of Kerema).

Specimens examined. Papua New Guinea: ♂♀ BM(NH) 73.136–137 Maul, Mount Suckling, 300 m (BM(NH) 73.136 skin, skull, 73.137 in alcohol; coll. J. I. Menzies).

Remarks. These appear to be the first of *O. papuensis* to be reported since its description: they conform closely to the original account. The dorsal surface is reddish brown, the hairs slightly paler at the base, the overall colour a little darker on the crown, the lower back and along the junction of the wings with the body. There is a band of paler, light brown hairs across the shoulders. The ventral surface is a paler reddish brown than the back, with a diffuse, slightly paler area across the base of the throat. The skull is as it is described by Lawrence but the male skull examined has a low sagittal crest that extends posteriorly to join slight lambdoidal ridges. As Lawrence points out, these project forward in an anteriorly directed V-shape to leave the rear of the skull smoothly rounded.

External measurements (BM(NH) 73.136, 73.137): length of forearm 49·6, 50·2; cranial measurements (BM(NH) 73.136): greatest length of skull 19·6; condylobasal length 17·9; condylocanine length 17·2; basal length 16·1; length from posterior edge of narial aperture to highest point of cranium 14·7; least interorbital width 4·3; zygomatic width 10·4; width of braincase 9·4; mastoid width 10·6; bottom of bulla to highest point of braincase 9·7; height of jugal projection of zygoma 2·1; c^1–c^1 (alveoli) 4·2; m^3–m^3 (alveoli) 7·9; i^2–m^3 8·2; c–m^3 7·2;

length complete mandible from condyles 12·2; length right ramus from condyle 12·5; c–m_3 7·5.

Discussion. Two species of *Otomops* occur in New Guinea: the other, *O. secundus* Hayman, 1952, known so far from Tapu, Upper Ramu River Plateau, Papua New Guinea, differs from *O. papuensis* chiefly in its longer forearm (length 57–58), dark chocolate brown general coloration, the presence of a broad, well-defined buffy grey mantle and of a narrow but conspicuous line of white hairs along the dorsal surface of the endopatagium at its junction with the body. There is also a patch of white hairs at the anterior part of the inner or medial base of each ear, flanking the interaural pocket, a point unremarked by Hayman in the original account. A similar patch of hairs occurs in *O. wroughtoni* (Thomas, 1913) from India but the base of the outer margin of the ear in *O. secundus* lacks the sprinkling of white hairs found in this species. There is no white at the base of the ear in *O. papuensis,* the hairs instead a rich reddish brown with slightly paler bases. *Otomops secundus* seems in fact nearer in external size and coloration to *O. formosus* Chasen, 1939 from Java or to the larger *O. wroughtoni.* The representation of all except *O. wroughtoni* is small: all have skulls essentially similar in structure, while the skull of *O. secundus* is closely similar in size to that of *O. papuensis.*

Summary

In the Megachiroptera *Rousettus amplexicaudatus stresemanni* from New Guinea is considered a valid subspecies; further material of the Sulawesian species *Rousettus celebensis, Styloctenium wallacei* and *Thoopterus nigrescens* is reported and where appropriate discussed; a number of species of *Dobsonia* are reviewed; Indo-Australian *Cynopterus* are examined in detail and *C. titthaecheileus* considered specifically distinct; Javan *Chironax melanocephalus* is re-described and further examples are reported from Sumatra and Sulawesi; a series of *Harpyionycteris celebensis* is reported and discussed; *Nyctimene celaeno* is provisionally considered specifically distinct; *Eonycteris* in Indo-Australia is briefly reviewed and the nomenclature of *Macroglossus* re-examined; *Synconcyteris* is reviewed and further specimens of *Notopteris macdonaldi macdonaldi* are reported and discussed.

Among the Microchiroptera *Rhinolophus celebensis* and *R. borneensis* are considered distinct species and their subspecies allocated with *R. importunus* considered a subspecies of the latter. The Sulawesian *Hipposideros dinops pelingensis* and *H. inexpectatus* are compared. Indo-Australian *Myotis* have been examined in some detail with a review of *M. muricola* and *M. mystacinus*; *M. ater* is considered a distinct species and the status of *M. australis* Dobson, 1878 discussed; the large-footed species *M. horsfieldii, M. hasseltii* and *M. adversus* are reviewed and keyed and a new subspecies, *M. adversus orientis* is described from the New Hebrides. Certain Indo-Australian *Pipistrellus* are briefly reviewed, notably *P. tenuis,* and the second known specimen of *P. societatis* is reported. A new species of *Hesperoptenus, H. gaskelli,* is described from Sulawesi. Indo-Australian *Miniopterus* are reviewed in detail and recent revisionary work on this part of the genus is discussed with a number of proposed changes in its classification: *M. solomonensis* Maeda, 1982 is considered a subspecies of *M. australis*; *M. macrocneme* Revilliod, 1914 a subspecies of *M. pusillus*; *M. oceanensis* Maeda, 1982 a subspecies of *M. schreibersii*; *M. macrodens* Maeda, 1982 a subspecies of *M. magnater*; *M. propitristis* Peterson, 1981 conspecific with *M. tristis*; the status of *M. bismarckensis* Maeda, 1982 is discussed. Occurrences of *Murina* east of Wallace's Line are examined and further specimens of *Tadarida (Chaerephon) jobensis bregullae* and *Otomops papuensis* are reported.

The following new records and range extensions are reported in this paper: *Dobsonia viridis (?) viridis* from Sulawesi; *Cynopterus brachyotis brachyotis* from Burma and *C. titthaecheileus* and *Macroglossus sobrinus sobrinus* from Krakatoa I; *Megaerops (?) ecaudatus from* northeastern India; *Aethalops alecto* from Java; *Taphozous melanopogon* from Sulawesi; *Megaderma spasma niasense* from Siberut I; *Rhinolophus pusillus pusillus, Hipposideros ridleyi* and *Coelops robinsoni* from Borneo; *Myotis muricola (?) browni* from Sulawesi; *M. ater* from Siberut I, *M. hasseltii continentis* from Burma; *Pipistrellus vordermanni* from Borneo; *Miniopterus australis tibialis* from Sulawesi, *M. pusillus* and *M. magnater macrodens* from Sumatra; *Murina suilla* and *M. tubinaris* from Thailand, *M. cyclotis peninsularis* from Borneo; *Kerivoula papillosa (?) malayana* from Sulawesi and *Tadarida (Mormopterus) beccarii* from Australia.

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Addendum

While this paper was in press a further contribution by Maeda *et al.* (1982) became available in London. On the basis of specimens from Sabah these authors considered *magnater* a distinct species and suggested that the specimens in the British Museum (Natural History) from Hong Kong (BM(NH) 65.1017 (sic), Pahang (BM(NH) 67.217) and Upper Burma (BM(NH) 32.11.1.3) might represent it. They also suggested that the forearm lengths given by Lekagul & McNeely (1977) for *schreibersii* in Thailand and by Medway (1978) in Malaya indicated that specimens referable to *magnater* might have been included. This study clearly antedates the more detailed work by Maeda (1982).

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